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EPA WORK ASSIGNMENT NUMBER: 208-9LC1  
EPA CONTRACT NUMBER: 68-01-7250  
CORRESPONDENCE NUMBER: RMIX/89-0009/SA  
EBASCO SERVICES INCORPORATED

FINAL  
REMEDIAL INVESTIGATION REPORT

WASTE DISPOSAL INC.  
SANTA FE SPRINGS, CA

NOVEMBER 1989

VOLUME I

NOTICE

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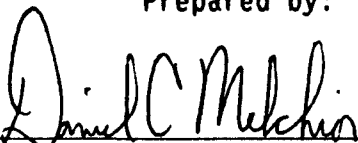
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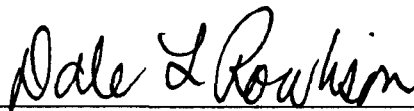
VOLUME I

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## EXECUTIVE SUMMARY

This report presents the results of the Remedial Investigation (RI) work conducted as part of a Remedial Investigation/Feasibility Study (RI/FS) for the Waste Disposal Incorporated site in Sante Fe Springs, California. This work was performed in response to the U.S. Environmental Protection Agency (EPA) Work Assignment No. 208-9LCI under Remedial Engineering Management (REM) III Contract No. 68-01-7250.

The specific objectives of the RI are as follows:

- o To characterize the nature and extent of contamination of soil, groundwater and subsurface gas at the WDI site;
- o To provide sufficient information for the WDI treatability and feasibility study to identify the feasible technologies for remediation of soil, groundwater, and subsurface gas;
- o To assess the fate and transport of contaminants in the WDI subsurface environment based on the WDI hydrogeologic and geologic characteristics;
- o To provide the data required for assessing the present and future risks to the public health and the environment associated with exposure to the surface and subsurface soil, groundwater, and subsurface gas; and
- o To provide the EPA with a list of major data gaps and recommendations for any supplementary remedial investigations which may be necessary to reduce uncertainties about the physical and chemical characteristics of soils at the WDI site.

The WDI site consists of a 43-acre parcel of land which was operated as a landfill and over a period of almost 40 years, accepting various oil-field and industrial wastes. The wastes were contained in a 1,000,000-barrel

capacity concrete-lined reservoir and several unlined waste handling areas. Prior to 1949, operations at the facility were unregulated; between 1949 and 1965-66, Waste Disposal, Inc. operated the facility as a permitted landfill. Waste disposal also occurred outside of the reservoir to the northwest, southwest and south of the reservoir inside dikes and to the northwest and southwest of the reservoir outside dikes.

A review of the site's history as documented in the County of Los Angeles records indicates that a waste disposal permit was given to Fernando Caneer on August 3, 1949, to operate the reservoir for disposal of solid fill, rotary mud and other non-acid oil-well waste. On March 8, 1950, Waste Disposal, Inc. was given an industrial waste permit to accept rotary drilling mud, clean earth, rock, sand and gravel, paving fragments, concrete, brick, plaster, steel mill slag and dry mud-cake from oil-field sumps. Under a separate waste disposal permit on August 5, 1953, WDI began accepting waste materials containing acetylene sludge. On March 15, 1955, WDI was permitted to annex an area to the west of the reservoir which was used for disposal of drilling mud.

At least twice during the facility operation, respectively in 1956 and 1962, the WDI reservoir and dike system was inadequate to contain liquid wastes, sludges and mud. During these incidents, waste materials spilled from the WDI dike system onto the adjacent properties to the east and southeast of the reservoir area. Waste materials containing oil-well mud were also dumped into deep sump holes located to the west of the WDI reservoir. However, disposal of liquid wastes to the unlined waste handling areas occurred regularly after 1957.

Several studies have been previously conducted to assess the presence of chemical contamination in the WDI soils and groundwater. Among these studies, Dames and Moore (1984, 1985 and 1986) performed preliminary remedial investigations at the WDI reservoir, and its adjacent properties including the area formerly occupied by the Toxo Spray Dust, Inc., west of the reservoir, the Campbell property in the south and the St. Paul High School athletic field along the northeast border of the reservoir. In

general, total metals levels above Soluble Threshold Limit Concentrations (STLCs) and moderate levels of semi-volatile organic compounds were detected in several areas, and methane and nonmethane subsurface gases were found in the Toxo Spray and Campbell property areas. Groundwater samples collected from monitoring wells installed upgradient and downgradient of the reservoir did not show any contamination by CAM metals and EPA priority pollutants.

Based on these preliminary results, Ebasco designed and implemented a comprehensive RI program for the WDI site to assess the nature and extent of chemical contamination in soils, groundwater and subsurface gas. The soil investigation program consisted of one hundred (100) soil borings drilled to a minimum depth of 35 feet in and around suspected contaminated areas. At least three soil samples were collected and analyzed for volatile organics, semi-volatile organics, pesticides/PCBs and metals. Soil samples were evaluated in the field for any visible contamination and were used also for the lithologic interpretations.

Twenty seven (27) soil borings were drilled below the water table and converted to the groundwater monitoring wells. Groundwater elevations were measured at these wells and water samples were collected and analyzed in the laboratory to detect the presence of volatile organics, semi-volatile organics, pesticides/PCBs and metals in the WDI groundwater. Twenty-six (26) soil borings drilled in the vadose zone were converted to subsurface gas monitoring wells. Gas samples collected from these wells were used to determine the presence of any subsurface gas contamination at WDI.

As observed in the soil borings, the WDI geology is characterized by fluvial deposits consisting of coarse grained, occasionally pebbly channelized sands surrounded in places by finer grained, lower energy and laterally extensive beds. In general, the WDI site is covered by 5 to 15 feet of artificial fill material underlain by a silt layer approximately 10 to 25 feet thick. Below the silt layer is at least 50 feet of a sandy, pebbly, channelized network of braided river deposits. Within the reservoir, contaminated materials described as black sludge was observed below the fill material to the depth of approximately 18 to 23 feet (depth of reservoir's concrete bottom). Black sludge was also present in the immediate surrounding of the

reservoir. Free liquids were observed in several borings at approximately 10 feet below the ground surface. Several areas in the adjacent properties along the south, southeast, and southwest borders have also some visible indication of contamination.

The laboratory analyses of soil, groundwater and subsurface gas samples indicate that subsurface soil is the most prevalent contaminated medium at the WDI site. The WDI reservoir is the main contaminated area containing high concentration of metals and volatile organics. Among metals of concern, arsenic, cadmium, copper, lead and mercury were present in concentrations above the STLC and the lead concentration was also higher than the Total Threshold Limit Concentration (TTLC). The detected volatile organics in the reservoir area include 2-butanone, acetone, benzene, ethylbenzene, methylene, chloride, toluene and xylene that were found in 13 to 50 percent of the samples. Several semi-volatile organics, pesticides/PCBs were also detected in the reservoir area. However, most of the contamination appears to be confined to the concrete-lined area. Elevated concentrations of metals and volatile organics were also detected in the WDI waste handling areas. Semi-volatile organics, pesticides and PCBs were found in low frequencies in the areas outside the WDI reservoir. The subsurface soil on the Toxo Spray Dust and Campbell properties to the southwest and south of the reservoir contain chemical compounds that are similar in type to the compounds found in the WDI reservoir and waste handling areas but are somewhat lower in concentrations.

The results of the chemical analyses of WDI groundwater show that metals are the most widespread of contaminants. Metals were detected at both upgradient and downgradient of the WDI reservoir. Highest concentrations of metals were detected in the upgradient wells. Trichloroethene above the MCL standard was found in only one well. Bis(2-chloroethyl) ether was the only semi-volatile organic compound that was detected at more than one well but it was not found consistently throughout the site. Pesticides and PCBs were not detected in any of the monitoring wells.

The analytical results of subsurface gas sampling show that several organic gases are present in the WDI reservoir and its waste handling areas. The detected gases include 1,1,1-Trichloroethane, 1,2-Dichloroethene, benzene, chloroform, methane, tetrachloroethane, trichloroethane and vinyl chloride. The reservoir and immediate surrounding area contain subsurface vinyl chloride, benzene and lower concentrations of chlorinated hydrocarbons.

The overall conclusion reached from the RI is that the WDI reservoir is the most contaminated area containing high concentrations of metals and volatile organics. The areas used previously as waste handling areas also contain elevated levels of contamination in the soil. The groundwater under WDI is relatively free of contamination. Due to the presence of a concrete layer at the bottom of the reservoir, waste migration may not have occurred below the concrete bottom. However, the waste handling areas are not lined and therefore, waste presence and migration may be considered a potential health hazard in these areas. Subsurface gas presence in the WDI reservoir and waste handling areas may also pose a health hazard and its remediation may be needed.

## 1.0 INTRODUCTION

This report contains the results of the Remedial Investigation (RI) for the Waste Disposal Incorporated (WDI) site in Santa Fe Springs, California. This Remedial Investigation/Feasibility Study (RI/FS) was conducted in response to the U.S. Environmental Protection Agency (EPA) Work Assignment No. 208-9LC1 under Remedial Engineering Management (REM) III Contract No. 68-01-7250.

This RI report summarizes and interprets the information presented in three earlier media characterization reports on the WDI soil, groundwater and subsurface gas. Information is also presented here on the nature and extent of contamination, and fate and transport of contaminants in the subsurface. An assessment of health risks associated with the WDI contaminants is currently being conducted and will be reported separately.

The information presented will be used to identify and evaluate appropriate remedial technologies during the WDI feasibility study. The nature and extent of existing contaminants along with the estimated remedial action levels for each media will serve as a basis for assessing the feasibility of various remedial technologies.

### 1.1 OBJECTIVES

The specific objectives of the RI are as follows:

- o To characterize the nature and extent of contamination of soil, groundwater and subsurface gas at the WDI site;
- o To provide sufficient information for the WDI treatability and feasibility study to identify the feasible technologies for remediation of soil, groundwater, and subsurface gas;
- o To assess the fate and transport of contaminants in the WDI subsurface environment based on the WDI hydrogeologic and geologic characteristics data;

- o To provide the data required for assessing the present and future risks to the public health and the environment associated with exposure to the surface and subsurface soil, groundwater, and subsurface gas; and
- o To provide the EPA with a list of major data gaps and recommendations for any supplementary remedial investigations which may be necessary to reduce uncertainties about the physical and chemical characteristics of soils at the WDI site.

## 1.2 SITE BACKGROUND

This section provides a site description, site history and a summary of previous investigations and studies associated with the WDI site. An extensive review of previous studies has been presented in the three media characterization reports. The results presented in previous studies served as a basis for the RI activities.

### 1.2.1 Site Description

The Waste Disposal, Inc. (WDI) site (latitude 37° 57.0'N, longitude 118° 03.0'W) consists of a 43-acre parcel located at T2S, R11W, S32 in the city of Santa Fe Springs, Los Angeles County, California (Figure 1-1). The site is bordered on the northwest by Santa Fe Springs Road, on the northeast by a Fedco food distribution center and St. Paul's High School, on the southwest by Los Nietos Road, and on the southeast by Greenleaf Avenue (Figure 1-2).

The WDI site was operated as a landfill which, over a period of almost 40 years, accepted various oil-field and industrial wastes. The wastes were contained in a 1,000,000-barrel capacity concrete-lined reservoir and several unlined waste handling areas. Prior to 1949, operations at the facility were unregulated; between 1949 and 1965-66, Waste Disposal, Inc. operated the facility as a permitted landfill. Details of waste materials disposed of at this site are not available. A profile of the site contamination, however, indicates the presence of hydrocarbons, oil-field wastes containing metals, and volatile organics in the subsurface materials.



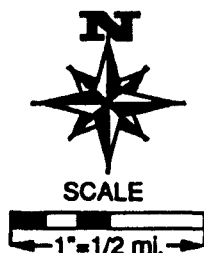
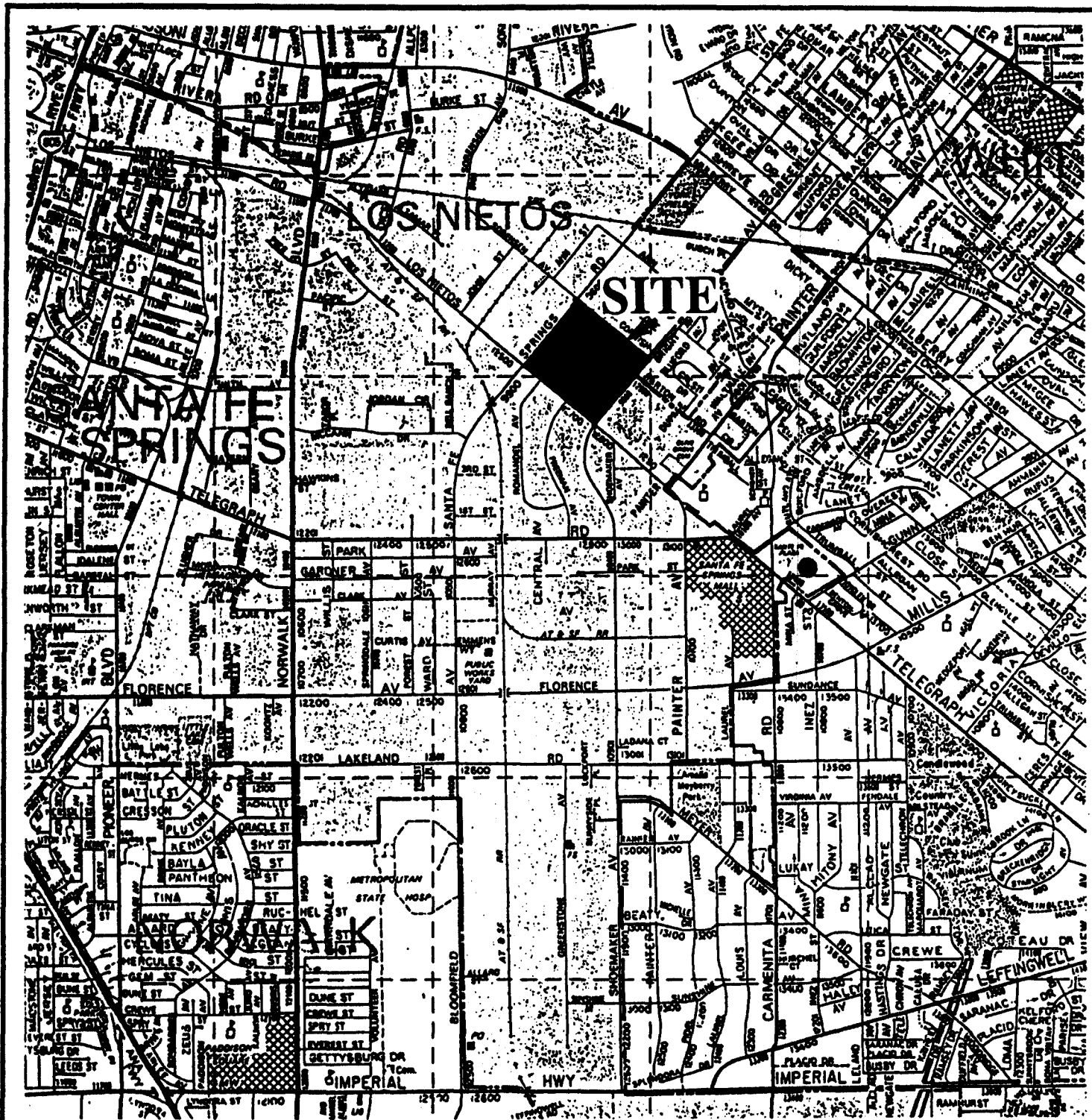
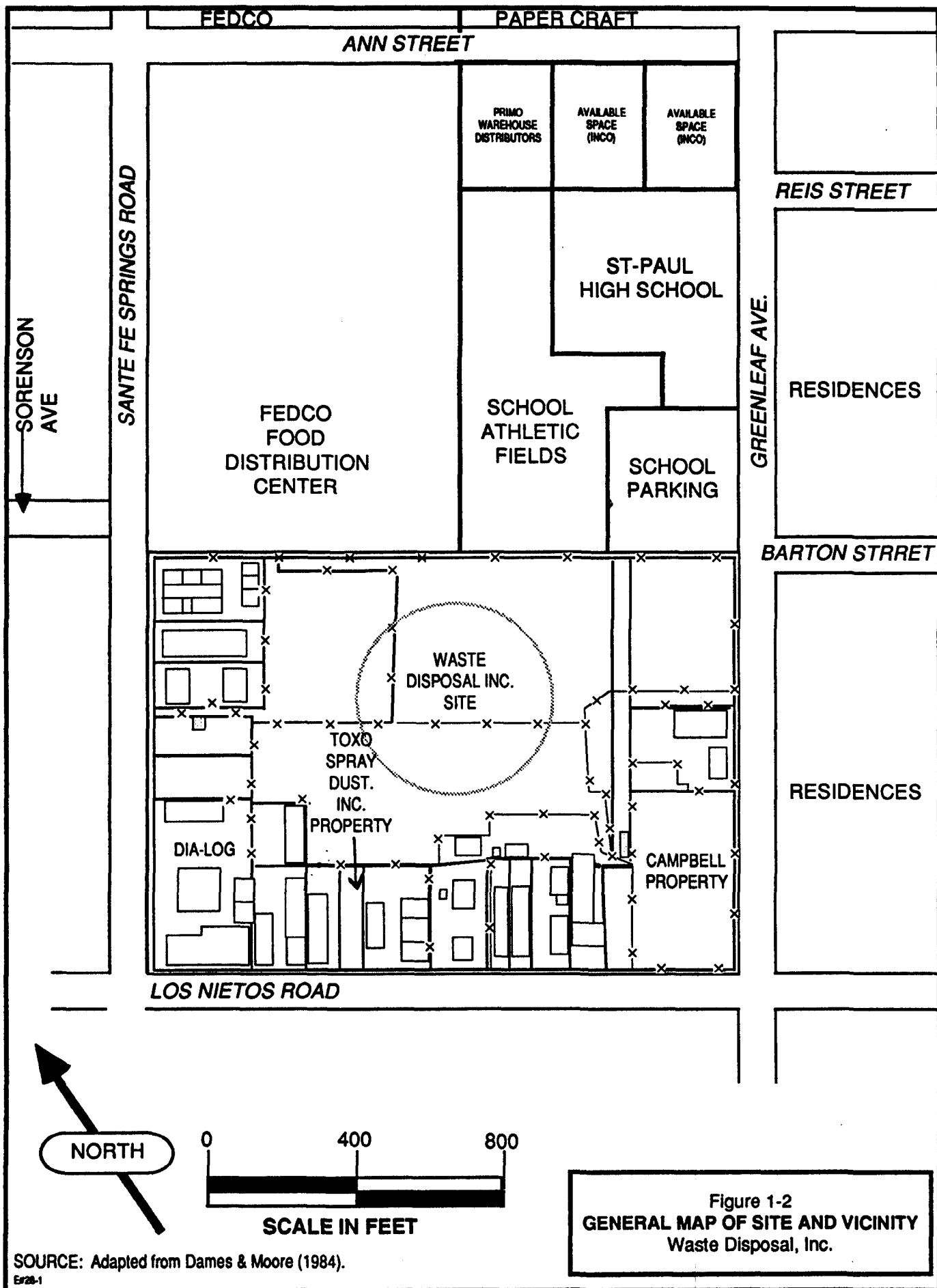


Figure 1-1  
GENERAL SITE LOCATION MAP  
Waste Disposal, Inc.

SOURCE: Adapted from Thomas Brothers Guide, 1988.



SOURCE: Adapted from Dames & Moore (1984).

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### 1.2.2 Site History

Waste disposal operations at the WDI from 1949 until closure were sporadically documented (Table 1-1). Many documents allegedly pertaining to the materials disposed have been destroyed (Herrera 1986). Thus, a comprehensive site disposal history is not available. However, the Potentially Responsible Party Search conducted by ICF Technology (1987) and a records search and review of aerial photographs, as described below, have provided some information regarding past waste disposal activities at WDI.

The Santa Fe Springs Oil Field was discovered by Union Oil Company of California in 1919. Sometime thereafter (probably between 1919 and 1928), a 1,000,000-barrel (42-million-gallon) capacity, concrete reservoir was constructed at the WDI site. The reservoir was apparently used for petroleum storage. In the late 1920s, the WDI reservoir was decommissioned. Aerial photographs (WCCA 1928, 1937, 1945) indicate that a similarly sized reservoir was located across Santa Fe Springs Road, approximately 800 feet to the northwest, on land owned by Union Oil Company.

A review of aerial photographs (EMSL 1988) shows evidence of waste disposal at the site between the late 1920s and 1949. A 1937 photograph indicates that standing liquid was present outside of the reservoir to the northwest, southeast, and south of the reservoir inside dikes, and to the northwest and southwest of the reservoir outside dikes. Disturbed ground as well as areas of fill were present along Greenleaf Avenue and Los Nietos Road (Figure 1-3). A 1945 photograph shows standing liquid in an excavation or pit at the corner of Greenleaf Avenue and Los Nietos Road (Figure 1-4).

On August 3, 1949, Fernando Caneer filed with the County of Los Angeles Regional Planning Commission, a request for hearing and an application to operate a dump in the reservoir for the disposal of "solid fill, rotary mud and other non-acid oil-well waste" (Tapking 1949, The Dumps 1949a, 1949b). On November 15, 1949, Special Permit 634 was granted to Fernando Caneer, Marvin Pitts, Nollie B. Hudson, and Delmar Carter for the above mentioned purposes by the County of Los Angeles Board of Supervisors upon recommendation of the County by Los Angeles, Regional Planning Commission (Lee 1949).

TABLE 1-1

**HISTORICAL RECORD OF WASTE COLLECTION, TREATMENT AND DISPOSAL,  
WASTE DISPOSAL, INC.**

Waste	Source of Waste	Quantities	Dates of Disposal	Reference
Petroleum Refinery Tank Bottoms	Union Oil, General Petroleum, Standard Oil, Rothschild, etc.	Unknown	Unknown	Whittier Daily News (1987, 1988)
Steel Mill Slag	Unknown	Unknown	Unknown	Whittier Daily News (1987, 1988)
Brewery Wastes	Unknown	Unknown	Unknown	Whittier Daily News (1987, 1988)
Cesspool Sewage	Santa Fe Springs Waste Water Disposal Co.	Unknown	1958-?	Otteson (1958), Grancich (1958b)
Rotary Drilling Mud*	Union Oil, General Petroleum, Standard Oil, Rothschild, etc.	15,000 barrels/wk	3/8/50-?	Industrial Waste Discharge Permit 57 Carter (1953)
Clean Earth, Rock, Sand and Gravel*	Unknown	Unknown	3/8/50-?	Industrial Waste Discharge Permit 57
Paving Fragments*	Unknown	Unknown	3/8/50-?	Industrial Waste Discharge Permit 57
Concrete, Brick, Plaster*	Unknown	Unknown	3/8/50-?	Industrial Waste Discharge Permit 57
Steel Mill Slag*	Unknown	Unknown	3/8/50-?	Industrial Waste Discharge Permit 57
Dry Mud Cake*	Oil Field Sumps	Unknown	3/8/50-?	Industrial Waste Discharge Discharge Permit 57
Acetylene Sludge*	Security Engineering	200 barrels/wk	8/5/53-?	Fox (1953)
	Chickson Co.	20 barrels/wk	8/5/53-?	
Liquid Residue from Railroad Car Washing Racks and Machine Shop	Holbrook and Sons, Southern Pacific Railroad B and H Vacuum, Union Pacific Railroad, George Casey Company	Unknown	1/15/62-? 5/9/65-?	Dump Inspection Reports (Moore 1962, 1965)
Odor Control Spray	Mr. Dell, LA County, Department of Engineer	Unknown	1958-?	Grancich (1958c)
Payzone	Unknown	Unknown	11/27/53-?	LA County Engineer Photo, File I-629
Unspecified Liquid Waste	Archer-Daniels-Midland, B and B Deburring Roberts Company	Unknown	1958-? 1958/ 1959-? 1958/ 1959-?	Committee Against Waste Disposal Inc. (1958) Coates (1959), Moore (1958), Collins (1959), Medley (1959)

\* Permitted Wastes.

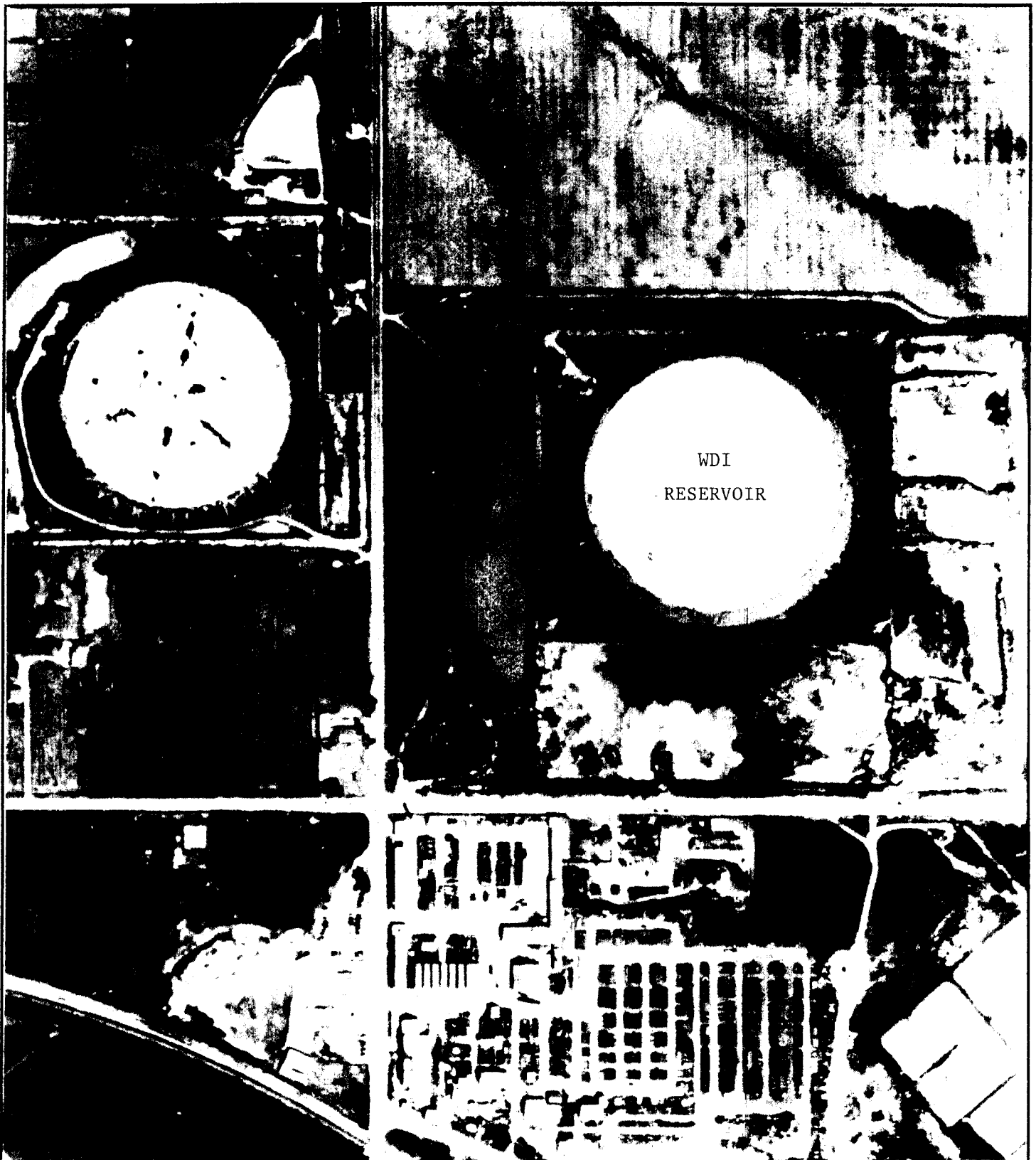
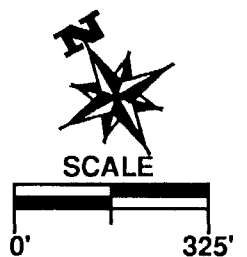


Figure 1-3  
1937 AERIAL PHOTO  
WASTE DISPOSAL INC.



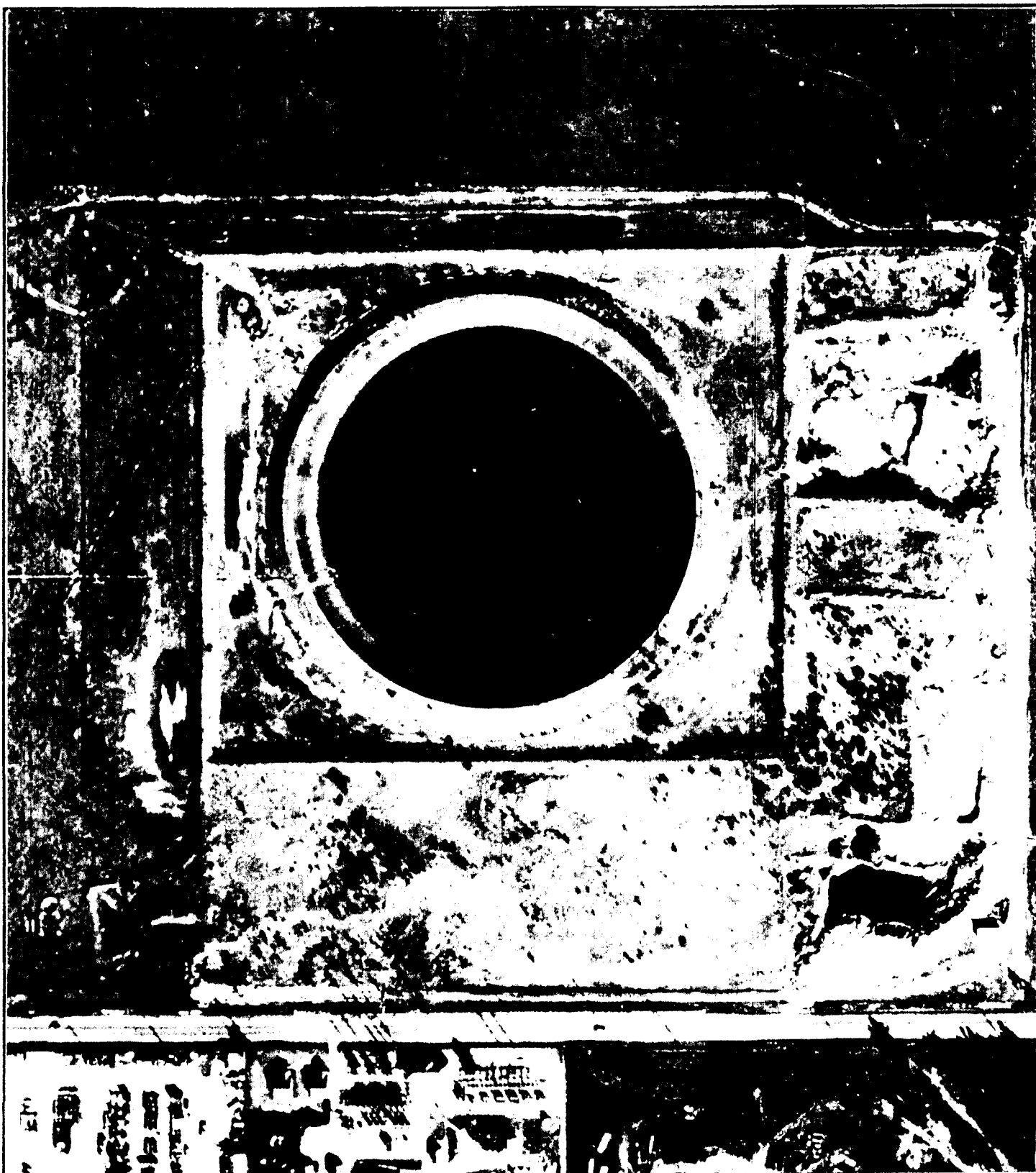
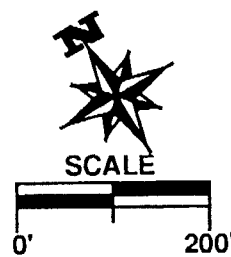


Figure 1-4  
1945 AERIAL PHOTO  
WASTE DISPOSAL INC.



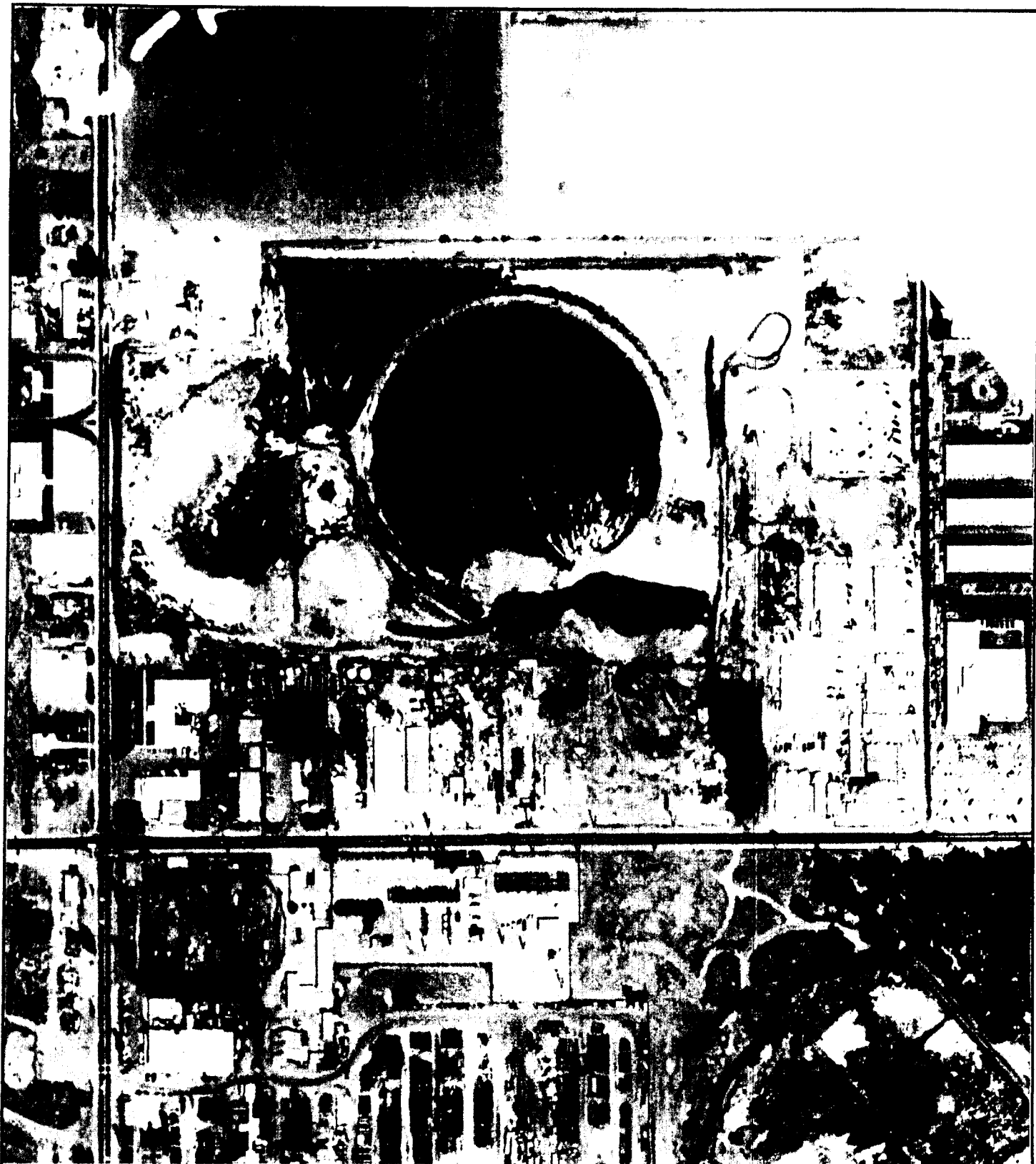
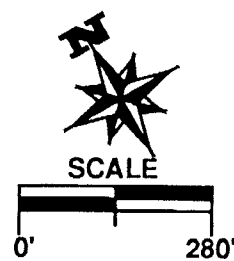


Figure 1-5  
1958 AERIAL PHOTO  
WASTE DISPOSAL INC.



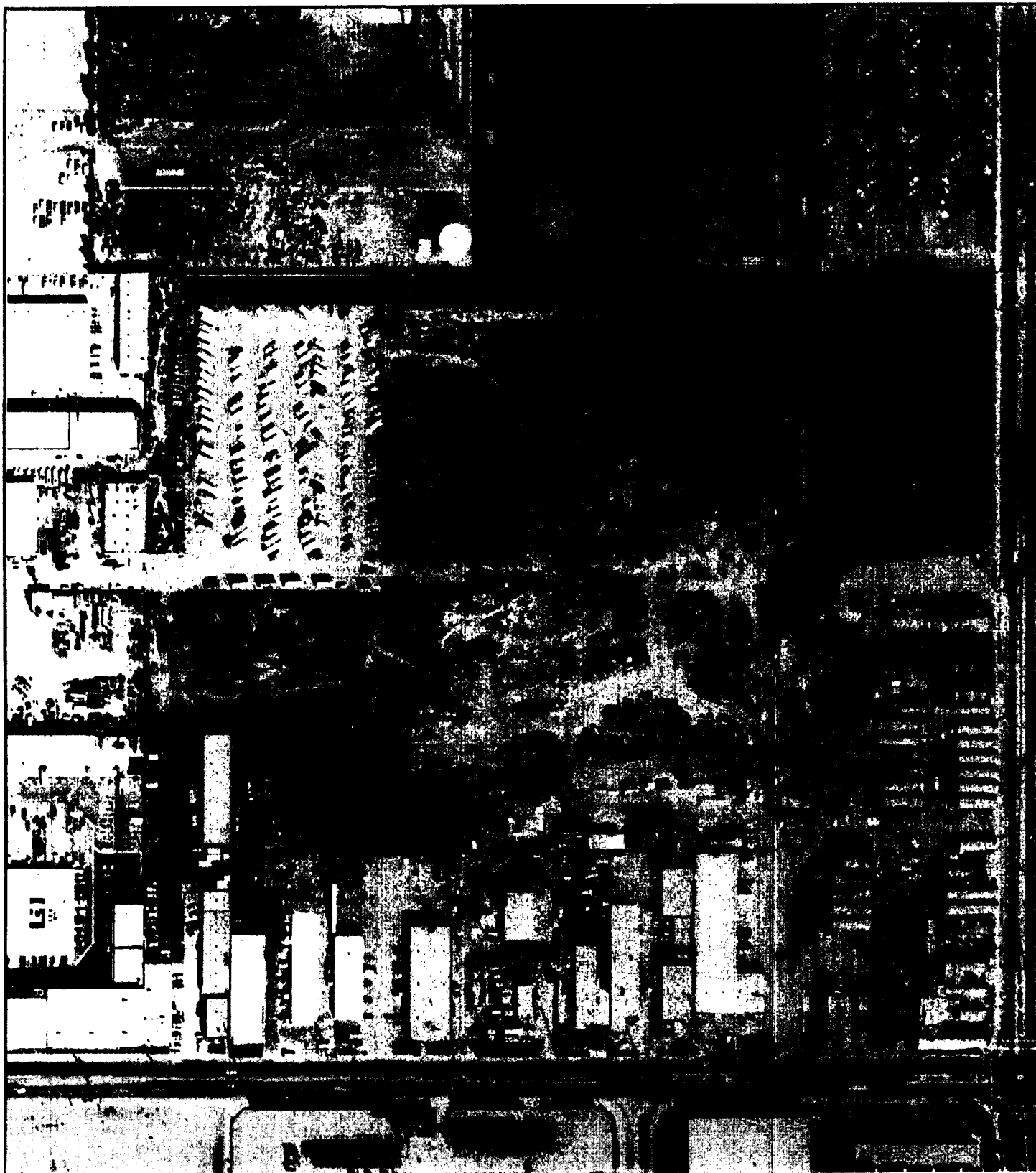


Figure 1-6  
1983 AERIAL PHOTO  
WASTE DISPOSAL INC.

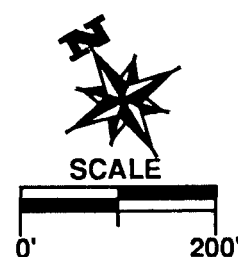




TABLE 1-2  
Summary of Previous Studies Relevant to the WDI Site

Number	Study Conducted By	Area of Study	Date	Purpose	Results
1	Advanced Foundation Engineering, Inc.	Southwest of reservoir near Los Nietos Road	1971	To conduct a geotechnical evaluation of the site.	Soil investigations indicated that the site's underlying geology consisted of fill material (0-3 feet), clayey silt and silty clay (3-15 feet) and sandy soil (15-20 feet).
2	Hammond Soils Engineering	Southwest of reservoir near Los Nietos Road	1975	To conduct a geotechnical evaluation of the site.	Fill and soil investigations indicated that the site was underlain by sandy silt and clay with some deleterious material and oil contaminated soil in the northern area (0-7.5 feet), central area (0-8.5 feet) and southern area (0-15 feet).
3	Moore and Tabor	Northeast corner of Greenleaf Avenue and Los Nietos Road	1981	To conduct a foundation investigation.	Soil investigations indicated that the site was underlain by loose fill consisting of silty sand or clayey silt (1-5 feet) and alluvial deposits consisting of interbedded, moderately dense to dense, fine to medium silty sandy and soft to very soft clayey and sandy silt (5-16 feet).
4	Dames and Moore	The WDI reservoir and the Campbell property areas	1984	To conduct Phase I remedial investigations.	Four soil borings were drilled and soil samples were collected and analyzed. Boring logs indicated that the site was covered by 4 to 9 feet of fill material underlain by a mixture of clay, silt and sand to the depth of about 20 feet. Metal concentrations above STLC were found in soil samples. Semi-volatile organics were also detected in several samples.
5	Dames and Moore	The WDI reservoir and the adjacent athletic field	1985	To conduct Phase II remedial investigations.	Field investigations included installation and sampling of three monitoring wells in the reservoir area and collection of 35 shallow soil samples from locations around the site. According to the boring logs, the site's geology consisted of clay-silt-sand mixture of varying distributions (up to -25 feet) and sandy-silt and fine to medium grained sand (25-70 feet). A boring log from a waste handling area indicated that the site was underlain by fill material (0-3 feet), mixture (14-22 feet) followed by fine to medium grained sand. Groundwater samples did not show contamination by CAM metals and EPA priority pollutants. Lead concentrations above STLC were detected in several soil samples but similar to background concentrations. No detectable concentrations of priority pollutants were found.

TABLE 1-2  
Summary of Previous Studies Relevant to the WOI Site  
(Continued)

Number	Study Conducted By	Area of Study	Date	Purpose	Results
6	Dames and Moore	Toxo Spray Dust, Inc.	1986	To conduct remedial investigations.	Soil and subsurface gas samples were collected and analyzed. The site was found to be contaminated by pesticide compounds. As a result, Toxo Spray Dust building and 16 cubic yards of soil was removed and transported to a Class I landfill. Methane and nonmethane gases also appeared to be present at the site.
7	Dames and Moore	Campbell Property	1986	To conduct remedial investigations; to locate and estimate the volume of waste handling areas.	Soil and soil-gas investigations and CPT (cone penetrometer test) soundings were conducted. Moderate levels of semi-volatile organics were found in soil samples. Analysis of soil-gas samples indicated the presence of methane and non-methane gases. Results of CPT data were used to estimate volume of waste handling materials.
8	John L. Hunter and Associates	Campbell Property	1987	To conduct soil sampling following unauthorized waste discharge.	Four soil samples were collected at waste discharge areas. Metal concentrations in the soil samples were below TTLC limits. The STLC of samples was exceeded for several metals. Nitrate concentration varied from 9 to 3,990 ppm.

On July 1, 1986, Dames and Moore (1986b) collected two samples from the flooring in the former dry-mix area of the Toxo production building. On July 9, 1986, six shallow soil vapor probes were installed. In September 1986, the Toxo operations building was demolished. Following the demolition, Dames and Moore collected two soil samples 10 inches below the former building location.

The results of this work are shown in the WDI Soil Characterization Report. Floor samples contained methylparathion, ethylparathion, endosulfan I, and endosulfan II. One of the soil-gas samples contained 231,000 ppm (23.1 percent by volume in air) of methane and 597 ppm of total nonmethane hydrocarbon as hexane. The soil samples contained malathion, ethylparathion and endosulfan I. Soils also contained concentrations of aldrin, 4,4'-DDE and 4,4'-DDT which exceed the State of California total threshold limit concentration (TTLC) limits for hazardous waste. This work resulted in the California Department of Health Services requiring that the Toxo Spray Dust building be demolished and hauled to a Class I landfill for disposal. Approximately 16 cubic yards of soil were excavated from the site. On March 31, 1987, this material was disposed of at a Class I landfill owned and operated by Chemical Waste Management, Inc., in Kettleman Hills, California (Proctor 1989).

Campbell Property - Dames and Moore conducted soil-gas sampling on the Campbell property on two occasions. During the first sampling activity in May 1986, Dames and Moore installed four organic vapor probes on the Campbell property to a depth of 5 feet. On June 25, 1986, Dames and Moore installed three shallow (5 to 6 feet) soil vapor probes and performed 21 cone penetrometer test (CPT) soundings at the Campbell property. The purpose of this work was to: (1) better estimate the extent of disposal areas and associated soft material at the site, and (2) utilize shallow vapor probes to assess the nature and concentration of organic vapors in the soils beneath the site. The results of soil-gas analyses indicated methane concentrations of 9,500 and 11,200 ppm in two of the samples and non-methane hydrocarbon concentration of 29 ppm in only one sample.

Each of the CPT soundings from the Campbell property were plotted and interpreted and the volume of waste and overburden materials were estimated to be between 10,000 and 16,000 cubic yards (Dames and Moore, 1986a). The CPT soundings show the presence of very soft sump materials possibly including desiccated muds and loose fill. Two approximations for the horizontal extent of the very soft material are shown on Figure 1-8. The inner zone, containing very soft material, has approximate dimensions of 100 feet by 175 feet with an average thickness of 10 feet. Very soft material was encountered as deep as 18 feet. Including the overburden, the inner zone volume would be 10,000 to 12,000 cubic yards. Assuming that the outer zone represents the margin of the sump, with generally shallower depths of sump material, the additional volume was estimated to be about 2,000 to 4,000 cubic yards.

Dames and Moore also drilled six (6) soil borings on the Campbell property. Four of these borings (DM-1, DM-2, DM-3, and DM-4) were drilled in areas where drilling muds were previously encountered in the shallow subsurface. Three borings (DM-4, DM-5 and DM-6) were located adjacent to the WDI site in order to evaluate whether hazardous chemical compounds have migrated across the property boundary. Samples were collected at approximately 2.5-foot intervals and borings were completed to depths ranging from 16.5 to 21.5 feet. Five soil samples with high OVA readings were retained for analysis under Title 22, California Code of Regulations (CCR) metals, U.S. EPA priority pollutant organics (Methods 8240 and 8270), and pH.

Moderate levels of naphthalene, di-n-butyl phthalate and 2-methylnaphthalene were found in DM-1 at a depth of 6.0 feet. Boring DM-2 contained moderate to high concentrations of naphthalene, fluorene, phenanthrene, and 2-methylnaphthalene at a depth of 8.5 and 11 feet. Ethylbenzene was found at 8.5 feet but not at 11 feet. Di-n-butyl phthalate, isophorene and chrysene were found at 11 feet but not at 8.5 feet. Boring DM-3 contained relatively high concentrations of naphthalene, fluorene, phenanthrene, and 2-methylnaphthalene at a depth of 16 feet. Detectable concentrations of di-n-butyl phthalate were found at a depth of 3.5 feet in Boring DM-4. The pH of soil samples was found to be between 7.9 and 8.4. All metal concentrations were reported to be below the total threshold limit concentration (TTLC) and all



### EXPLANATION

- BORING WHICH ENCOUNTERED SUMP MATERIAL
- BORING WHICH DID NOT ENCOUNTER SUMP MATERIAL
- CPT SOUNDING SUGGESTIVE OF VERY SOFT SUMP MATERIAL
- ▣ CPT SOUNDING SUGGESTIVE OF DESICCATED SUMP MATERIAL
- CPT SOUNDING SUGGESTIVE OF ABSENCE OF SUMP MATERIAL



0 80 100  
SCALE IN FEET

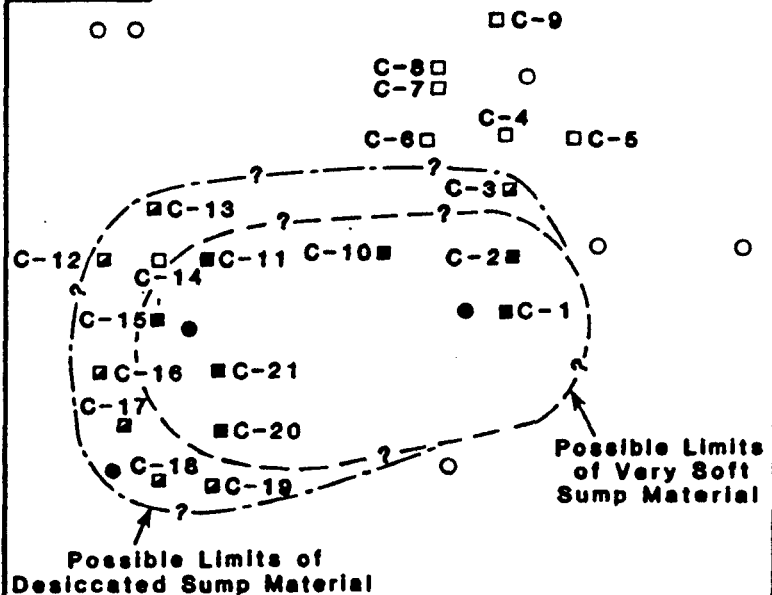


Figure 1-8  
CPT SOUNDINGS  
CAMPBELL PROPERTY

SOURCE: Adapted from Dames & Moore (1986).

but three metal concentrations were reported below the soluble threshold limit concentration (STLC), but the exact value of these concentrations was not reported.

Four soil samples were collected from the Campbell property on December 8, 1987, following the unauthorized discharge of plating solutions to the ground from this facility (Hunter 1988). All samples were analyzed for priority pollutant metals, nitrate and pH (using EPA method 9040). The laboratory analysis of samples indicated that the concentrations of metals for all samples were below the TTLC with the exception of sample number one which exceeded the TTLC for nickel. The STLC was exceeded for: chromium and nickel (samples 1, 2, 4); copper, zinc, and arsenic (sample 1); and cadmium and lead (all samples). However, a Waste Extraction Test (WET) was not performed. The concentration of nitrate varied from 9 to 3,990 ppm although sample number 2 contained no detectable concentration of nitrate. The pH of samples varied from 5.6 to 7.9.

Reservoir Area - During the week of September 28, 1984, Dames and Moore drilled 4 borings at the WDI site. One boring was drilled in the center of the concrete reservoir and was terminated at a depth of 22.5 feet. The remaining 3 borings were drilled around the perimeter of the reservoir and were terminated at depths which range from 18.5 to 23.5 feet. Samples were collected every 2.5 feet. The concentrations of organic vapors were measured using a portable HNu photoionization detector to determine which samples should undergo laboratory analysis. Selected samples were analyzed for California Assessment Manual (CAM) metals and U.S. EPA priority pollutant organics (Methods 8240 and 8270).

In March 1985, Dames and Moore collected 35 shallow soil samples from the WDI site, the St. Paul High School athletic field, and a vacant lot approximately 1,050 to 1,300 feet to the northwest of the WDI site. The two samples from the vacant lot were used to determine the background concentration of metals. These samples were collected with a stainless steel scoop from a depth of 1 foot. The samples were field tested for pH and screened for organic vapors using an HNu. Each of the samples was analyzed by a laboratory for CAM metals. Two of the samples were also analyzed for EPA priority pollutants using EPA Methods 8240 and 8270.

The results of Dames and Moore's laboratory analysis are shown in Tables 1-3 and 1-4. Although the WET (Waste Extraction Test) was not used on any of the samples collected from the Dames and Moore borings, the TTLC lab analysis showed that DMEB-1 contained levels of barium, cadmium, copper, lead, mercury, nickel, silver, vanadium and zinc which were above the respective STLC. DMEB-2 contained similar concentrations of all these metals, with the exception of silver and zinc. Results from DMEB-3 indicated only two metals, cadmium and vanadium, in concentrations which exceed the STLC. DMEB-4 results showed concentrations of barium, cadmium, copper, lead, nickel and vanadium which exceed the STLC.

Dames and Moore boring DMEB-1 also contained ethylbenzene, tetrachloroethene, toluene, trichloroethene, total xylenes, naphthalene and phenanthrene. DMEB-2 contained ethylbenzene, total xylenes and naphthalene. Note that the dilution of highly contaminated samples resulted in an increase in detection limits for many contaminants. This factor, combined with the compositing and analyzing soil samples over a depth range of as much as 12.5 feet, make it difficult to accurately characterize the extent and the concentration of contaminants.

Dames and Moore surface soil samples A-1, C-1, D-5, E-5 and E-6 contained lead concentrations which exceed the STLC. These concentrations, however, are generally similar to background concentrations of lead as indicated by the samples analyzed from the vacant lot. Concentrations of barium, copper and vanadium are present in concentrations below the STLC in samples from the WDI site but were not found at all in background samples. Neither of the two surface samples analyzed using EPA Methods 8240 and 8270 contained detectable concentrations of priority pollutants.

At about the same time, one upgradient (MW-1) and two downgradient (MW-2 and MW-3) monitoring wells were installed. The initial attempt to install MW-2 was abandoned when liquid waste was encountered at a depth of 5 feet. Black oily (solid) waste was also encountered during the drilling of MW-1. A sample of the waste from both these areas was collected and analyzed for EPA priority pollutant organics (Methods 624 and 625). Water samples were also collected from the three wells, once completed, and analyzed for EPA

TABLE 1-3  
METAL CONTAMINATION IN SURFACE SOIL SAMPLES (STLC RESULTS)  
AT WASTE DISPOSAL, INC.

Boring Number	Sample Number	Sample Type	Sample Depth (ft)	Ba (mg/l)	Cd (mg/l)	Cu (mg/l)	Pb (mg/l)	Hg (mg/l)	Ni (mg/l)	Ag (mg/l)	Th (mg/l)	Va (mg/l)	Zn (mg/l)
A-1		Soil	0-1	NA	BDL	BSL	9.6	NA	BSL	BDL	BDL	BSL	BSL
C-1		Soil	0-1	BSL	BDL	BSL	5.1	NA	BSL	BDL	BDL	BSL	BSL
D-5		Soil	0-1	BSL	BSL	BSL	6.2	NA	BSL	BDL	BDL	BSL	BSL
E-5		Soil	0-1	BSL	BSL	BSL	6.1	NA	BSL	BDL	BDL	BSL	BSL
E-6		Soil	0-1	BSL	BSL	BSL	14.0	NA	BSL	BDL	BDL	BSL	BSL

Source: Adapted from Dames and Moore (1985).

NA - Not Analyzed for STLC.

BDL - Below Detection Limits.

BSL - Below STLC Limits.

METAL CONTAMINATION IN SOIL BORINGS (TTLC)  
AT WASTE DISPOSAL, INC.

Boring Number	Sample Number	Sample Type	Sample Depth (ft)	Ba (ppm)	Cd (ppm)	Cu (ppm)	Pb (ppm)	Hg (ppm)	Ni (ppm)	Ag (ppm)	Th (ppm)	Va (ppm)	Zn (ppm)
DMEB-1	3	Soil	10	BSL	2.5	44	130	0.25	BSL	500	BSL	BSL	BSL
DMEB-1	Composite	Soil	12.5 to 20	310	2.6	57	250	BSL	38	BSL	BSL	45	2,300
DMEB-2	Composite	Soil	5 to 17.5	930	1.9	28	280	0.22	27	BSL	30	BSL	BSL
DMEB-2	6	Soil	17.5	120	2.0	28	BSL	BSL	22	BSL	BSL	49	BSL
DMEB-3	9	Soil	22	BSL	BSL	BSL	BSL	BSL	BSL	BSL	BSL	BSL	BSL
DMEB-3	10	Soil	11	BSL	1.6	BSL	BSL	BSL	BSL	BSL	BSL	32	BSL
DMEB-4	2	Soil	5	320	1.9	34	17		23			32	BSL

Source: Adapted from Dames and Moore (1984).

BSL - Below STLC Limits.



TABLE 1-4  
MAJOR VOLATILE AND SEMI-VOLATILE  
ORGANIC CONTAMINATION IN SOIL  
AT WASTE DISPOSAL, INC.

Boring Number	Sample Number	Sample Type	Sample Depth (ft)	Ethyl Benzene (ppb)	Tetrachloro-ethene (ppb)	Toluene (ppb)	Trichloro-ethene (ppb)	Total Xylenes (ppb)	Naphthalene (ppb)	Phenanthrene (ppb)
DMEB-1	3	Soil	10	1,800	BDL	3,100	BDL	15,000	29,000	24,000
DMEB-1	Composite	Soil	12.5 to 20	25,000	22,000	57,000	13,000	120,000	66,000	30,000
DMEB-2	Composite	Soil	5 to 17.5	1,900	BDL	BDL	BDL	4,800	13,000	BDL
DMEB-2	6	Soil	17.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
DMEB-3	Composite 9 and 10	Soil	22	BDL	BDL	BDL	BDL	BDL	BDL	BDL
DMEB-4	2	Soil	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Source: Adapted from Dames and Moore (1984).  
BDL - Below Detection Limits.

priority pollutant organics and CAM metals. Because monitoring well MW-3 was located near a pesticide storage area, the water sample from this well was analyzed by EPA Method 608 for organochloride pesticides and PCBs.

None of the Dames and Moore water samples contained detectable concentrations of either CAM metals or EPA priority pollutants. Monitoring well MW-3 did contain 12 ppb of chlordane which exceeds the California Department of Health Services action level for chlordane in drinking water (0.55 ppb). It should be noted that Dames and Moore completed all three groundwater monitoring wells so that the top of the screen on each was approximately 5 feet below the depth at which groundwater was first encountered.

The location and configuration (size and composition of parcels), history and results of previous remedial investigations at the WDI site were examined closely prior to the design of the RI field program. The type, volume and extent of waste disposal at WDI indicated that an extensive field investigation program was warranted.

### 1.3 REPORT ORGANIZATION

The RI report presented here consists of seven sections as follows:

- o Section 1.0, Introduction - This section provides background information regarding site location and physiography, facility history and operations, waste discharges and regulatory actions. The nature and extent of the contamination problem as identified through previous investigations are presented along with a brief description of the study areas, type of investigations and the results obtained from these previous studies.
- o Section 2.0, Site Investigation Activities - This section describes the RI field activities including the topographic and geophysical surveys and the meteorological and subsurface contaminant-source investigations. This section also provides detailed information regarding the number, location, design and construction of soil borings, groundwater monitoring wells and subsurface-gas wells.

- o Section 3.0, Physical Characteristics of the Site - This section describes the site surface features, demography and land use, climate, soils, geology and hydrogeology. The information presented in this section is based on site-specific data collected during the RI activities as well as information obtained from previous investigations on the WDI site or its general area.
- o Section 4.0, Nature and Extent of Contamination - This section presents the results of chemical analyses performed on the soil, groundwater and subsurface-gas samples from the WDI site. These results are used to determine the nature and extent of contaminated areas which are critical to identifying appropriate remediation technologies for this site.
- o Section 5.0, Contaminant Fate and Transport - This section describes the site-associated contaminant occurrence and distribution, the potential migration routes for these contaminants, including soil, groundwater and air, and the chemical and physical properties of the contaminants that are important to characterize their transport through these media.
- o Section 6.0, Summary and Conclusions - This section provides a summary of the findings from the RI activities at the WDI site and concludes with several recommendations for remedial action objectives.

## 2.0 SITE INVESTIGATION ACTIVITIES

Site investigation activities at WDI were designed to assess the nature and extent of contamination in soils, groundwater and subsurface gas. The major components of this field investigation program are summarized in Table 2-1 and described in the following sections.

### 2.1 BOUNDARY, TOPOGRAPHIC AND LOCATION SURVEYS

Boundary, topographic and location survey were conducted prior to initiating field sampling activities. The boundary survey identified the site borders and assisted in establishing boundary lines between properties. The topographic survey was conducted to define and measure site ground relief; to establish the horizontal scale between the locations of various site features; to establish a datum point for subsurface investigations; and to assist in identifying site drainage patterns. The location survey was conducted to establish boring and well locations, to assist in locating geologic anomalies, and to provide reference points above subsurface features.

Surveys were conducted with a theodolite and electronic distance measuring device. The accuracy for horizontal and vertical control points was third order. The precision of elevation measurements was to one-hundredth (0.01) of a foot on firm surfaces (concrete, well casing, etc.) and to one-tenth (0.1) of a foot on ground shots. The precision for distance measurement was one-tenth (0.1) of a foot. All data was referenced to state plane coordinates.

The full-scale topographic and location survey and the boundary survey maps as well as the surveyor's field notes are included in the WDI Soil Characterization Report (May, 1989). The results of these surveys are discussed in more detail in Section 3.0.

On March 8, 1950, the County of Los Angeles, Department of the County Engineer, issued to Whittier Area Disposal Co. (also known as Waste Disposal, Inc.) Industrial Waste Permit 57 for operation of the dump, allowing acceptance of rotary drilling mud, clean earth, rock, sand and gravel, paving fragments, concrete, brick, plaster, steel mill slag, and dry mud cake from oil field sumps. In addition, Industrial Waste Permit 57 included provisions for rotary drilling mud and all suitable solid fill material. At the time, the one million barrel capacity reservoir, located in the center of the site, was surrounded on three sides by an earth dike, which was itself surrounded by a channel. Many unlined ponds and waste handling areas also existed at the site.

On August 5, 1953, a request by Fernando Caneer on behalf of Waste Disposal, Inc., to accept acetylene sludge for disposal was granted by the County of Los Angeles, Department of County Engineer. At the time, Waste Disposal, Inc., was disposing 15,000-barrels of rotary mud per week and wished to accept 200-barrels per week of acetylene sludge from Security Engineering and 20-barrels per week of acetylene sludge from Chicksan Company.

On April 21, 1953, Special Permit 634 was amended to allow 24 hour per day operation of the site (Esse 1953). On March 15, 1955, Special Permit 1032 was issued by the County of Los Angeles, Regional Planning Commission, to allow Waste Disposal, Inc., to annex an area 600 feet north of Los Nietos Road, and west of the reservoir for the disposal of drilling mud (O'Grady 1955, Pitts 1955, Breivogel 1955, 1956).

At least twice during facility operation, the reservoir and dike system was inadequate to contain disposal liquids, sludges and mud. In 1956, liquid wastes flowed into and were pumped through "gopher holes" in the dike into a surrounding channel and toward Greenleaf Avenue (Matthiesen 1956a). The flow of this liquid, which was estimated to be 5 gallons per minute (Matthiesen 1956b), also spilled onto an adjacent property. During the winter of 1962, after heavy rain, liquids containing oily substances seeped through the northerly dike onto the nearby St. Paul's Catholic High School grounds, traveling as far as the baseball diamond (Moore 1962a, 1962b).

The practice of dumping oil well mud to the west of the reservoir began as early as 1950, and by 1955 "numerous deep sump holes filled with material and oil sludge" occupied many areas outside the reservoir (Tweedy 1950, Waste Disposal, Inc., 1955). However, on May 9, 1957, for the first time since the facility was permitted, Fernando Caneer was observed pumping liquid from the reservoir to an adjacent unlined waste handling area (Otteson 1957). After this incident, the ground surface and unlined waste disposal areas surrounding the reservoir were used regularly for the disposal of liquid wastes.

According to County of Los Angeles, Department of County Engineer, Industrial Waste Division, Dump Inspection Reports, when disposal of liquids in the reservoir was discontinued, liquids were sometimes disposed of on the ground (Otteson 1958). The companies responsible for these practices were observed on at least two occasions on July 17, 1958, when B and H Vacuum discharged liquids from Union Pacific Railroad and on May 9, 1965, when Hollbrook and Sons discharged truck washings (Grancich 1958a, Otteson 1962, Moore 1965).

Buildings adjacent to WDI's eastern edge, along Greenleaf Avenue, also discharged waste liquids onto the WDI site. Two of these companies were identified as B and B Deburring and the Roberts Company. Liquids from these sources were found by County of Los Angeles, Department of County Engineer, Industrial Waste Division inspectors, along the southern edge of the WDI site (Coates 1959, Moore 1958, Collins 1959, Medley 1959). "Ponding" of these waste liquids also occurred along the entrance road from Los Nietos Road to the WDI site (Moore 1958).

As early as July 29, 1953, the Los Angeles County sewer system received liquids from WDI: "Waste water is discharged after suitable treatment by temporary pipe line into the sanitary sewer" (Fox 1953a). Waste water appears to have been discharged into a channel leading to Greenleaf Avenue. Later, a pipe was installed to allow liquids to flow directly onto Greenleaf Avenue and into the sewer. Sometime after March 1960, a pipe from WDI was connected to the Los Angeles County sewer system with approval from the County of Los Angeles, Department of Sanitation (Partin 1956b, Carothers 1956, Medley and Coates 1960).

A 1958 photograph shows standing liquid in the reservoir, the northern corner of the waste handling area surrounding the reservoir and the area west of the reservoir (Figure 1-5). Beginning in October 1958, however, solid fill was accepted and used to grade over the site (Grancich 1958b). By September 1961, the concrete reservoir was 50 percent full; by June 1962, it was 75 percent full; by November 1962, the reservoir was completely full of solid material and liquids flowed into diked areas (Moore 1962c, 1962d). By October 1964, the site was closed to the public; final grading of the site with topsoil continued until the end of 1966. A 1983 photograph shows that several businesses have moved onto the site since it was closed for dumping (Figure 1-6).

### 1.2.3 Previous Investigations

The WDI site currently consists of many individually owned parcels of land. Several of these parcels and the central portion of the site, which contains the reservoir and several sumps, have been the focus of previous site investigations (Figure 1-7). A summary of these investigations is provided in Table 1-2. Information from previous studies was used during planning of RI field activities but has not been used to estimate the extent of contamination at the WDI site.

The studies conducted by Dames and Moore were designed to assess the nature and extent of subsurface contamination at the WDI site. These studies focused on the characterization of the soils and subsurface gas in the Toxo Spray Dust area, Campbell Property and the general reservoir area (Figure 1-2). The study conducted in the reservoir area also included groundwater sampling and analysis at three monitoring wells installed around the perimeter of the WDI reservoir. The results of these investigations are summarized in the following sections.

Toxo Spray Dust - According to aerial photos of the WDI site (ASCS 1953), Toxo Spray Dust, Inc., (Toxo) first owned and operated a pesticide manufacturing and storage facility adjacent to the WDI reservoir in 1953.

Figure 1-7  
**PREVIOUS SITE INVESTIGATIONS**  
 Waste Disposal, Inc.

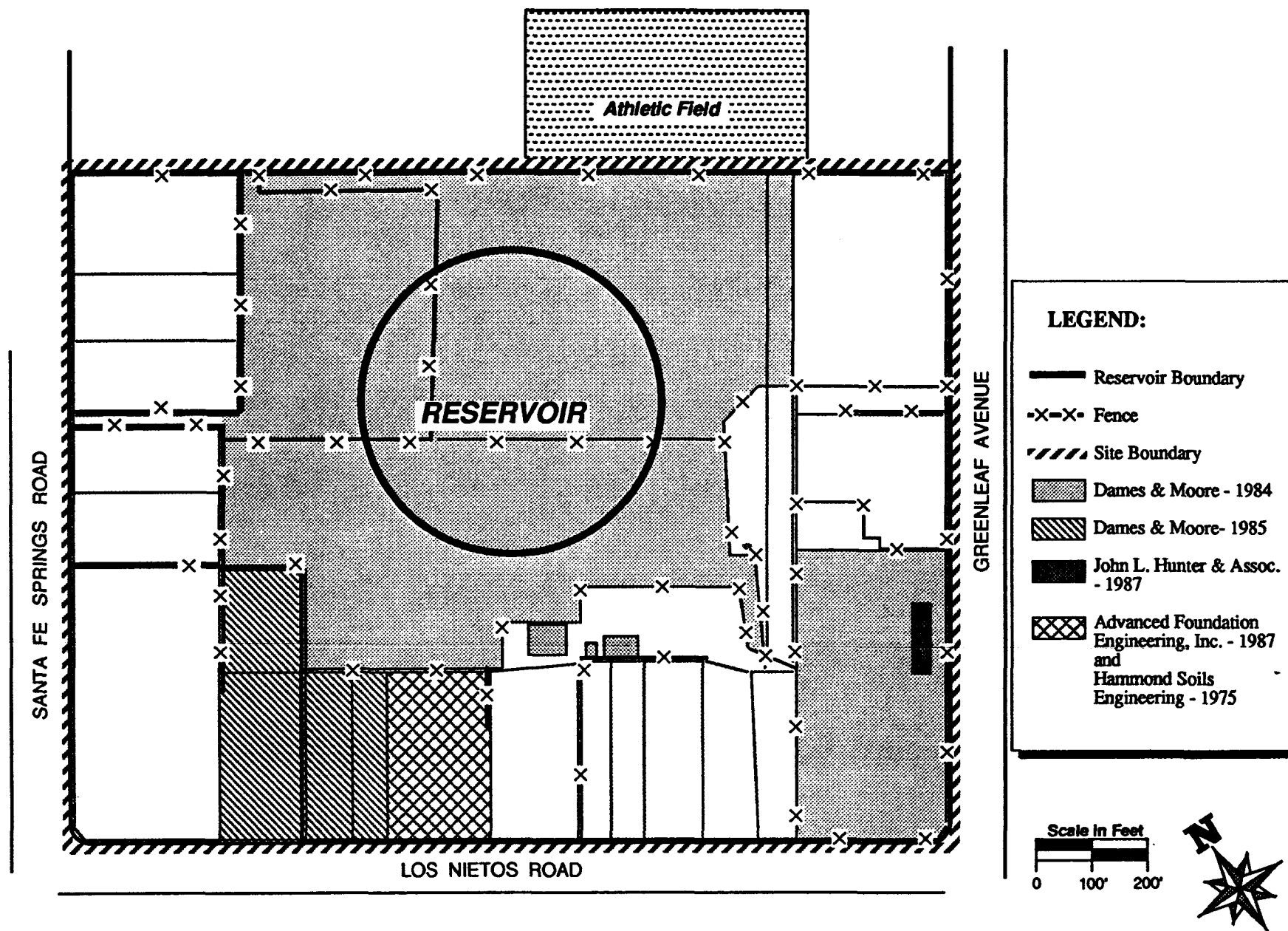




TABLE 2-1

## MAJOR COMPONENTS OF FIELD INVESTIGATION PROGRAM

Task Description	Objectives	Field Activities
o Boundary, Topographic and Location Surveys	<ul style="list-style-type: none"> <li>o To define site boundaries</li> <li>o To develop a topographic map showing site's drainage patterns</li> <li>o To establish location and elevation of various features, soil borings and monitoring wells, etc.</li> </ul>	<ul style="list-style-type: none"> <li>o Distance and elevation surveys were conducted by a theodolite and electronic distance-measuring device to an accuracy of <math>\pm 0.1</math> of a foot.</li> </ul>
o Ambient Air Monitoring	<ul style="list-style-type: none"> <li>o To monitor air temperature, wind direction and particulate matter emissions during field activities</li> </ul>	<ul style="list-style-type: none"> <li>o An air-monitoring tower was installed in the reservoir area. Temperature and wind directions were measured and recorded. Particulate matter concentrations were assessed.</li> </ul>
o Geophysical Investigation	<ul style="list-style-type: none"> <li>o To locate the concrete reservoir, waste handling areas and underground facilities prior to drilling</li> </ul>	<ul style="list-style-type: none"> <li>o Electromagnetic (EM) survey was conducted on a 100 x 100 ft grid on the site.</li> <li>o Ground-penetrating radar (GPR) was used to confirm the data or resolve discrepancies with the EM data.</li> <li>o Cone-penetrometer test (CPT) survey was used to confirm WDI disposal areas.</li> </ul>
o Soil Investigation	<ul style="list-style-type: none"> <li>o To estimate the nature and extent of soil contamination</li> <li>o To provide data required for estimating contaminated soil volume</li> <li>o To provide data needed to assess health risks and evaluate transport and fate of contaminants</li> </ul>	<ul style="list-style-type: none"> <li>o One hundred (100) soil borings were installed to a minimum depth of 35 feet in and around suspected contaminated areas.</li> <li>o Lithologic logs of all borings were kept.</li> <li>o A minimum of three samples per boring were collected for laboratory analysis.</li> <li>o Soil samples were tested with an explosimeter, an OVA and HNu in the field.</li> </ul>
o Groundwater Investigation	<ul style="list-style-type: none"> <li>o To estimate the nature and extent of groundwater contamination</li> <li>o To define the hydrogeologic conditions at the site</li> </ul>	<ul style="list-style-type: none"> <li>o Twenty-seven (27) soil borings were drilled below the water table and converted to groundwater monitoring wells.</li> <li>o Water levels and several groundwater properties were measured and recorded.</li> <li>o Groundwater samples were collected for laboratory analysis.</li> </ul>
o Subsurface-Gas Investigation	<ul style="list-style-type: none"> <li>o To estimate the nature and extent of subsurface-gas contamination</li> </ul>	<ul style="list-style-type: none"> <li>o Twenty-six (26) borings were converted to subsurface-gas wells.</li> <li>o Samples were collected from these monitoring wells for laboratory analysis.</li> </ul>

## 2.2 GEOPHYSICAL INVESTIGATION

Several geophysical surveys including electromagnetic conductivity (EM), cone penetrometer testing (CPT) and ground-penetrating radar (GPR) were conducted at the WDI site prior to initiating field sampling activities. The EM and GPR surveys were conducted to locate the concrete-lined reservoir and to determine the location of underground utilities and other buried objects which could interfere with drilling activities. The CPT techniques were used to locate the WDI waste handling and deposition areas. With the exceptions noted herein, geophysical investigations were generally conducted in accordance with the guidelines defined in the WDI Field Sampling and Analysis Plan (FSAP), Revision 2 (Ebasco 1988a) for electromagnetic, ground-penetrating radar and cone penetrometer testing surveys.

Electromagnetic (EM) terrain conductivity profiling was used on a reconnaissance basis to evaluate soil conductivity. The purpose of these measurements was two-fold. First, soil conductivity was measured to evaluate the applicability of ground-penetrating radar at the site. Second, soil conductivity was used to estimate the location and limits of the WDI reservoir and buried metal objects. A Geonics EM-31 conductivity meter with a penetration depth of approximately 15 to 20 feet was used in conjunction with a continuous chart recorder. The EM survey was based on a 100-foot by 100-foot grid developed during the topographic survey. Approximately 12,960 feet (140 stations) were surveyed and data was collected along every fourth traverse. The results of the EM survey are included in of the WDI Soil Characterization Report.

Ground-penetrating radar (GPR) was used to further investigate the magnetic anomalies found during the EM survey. The size, shape and burial depth of anomalous features including the concrete reservoir were investigated. A GPR system manufactured by Geophysical Survey Systems Inc., was used for this purpose. Depending on site conditions and ground cover, two antenna types (300 MHz and 500 MHz) were used to enhance penetration and reception. Data processing (i.e., filtering or averaging of data) was performed in the field.

A cone penetrometer test survey (CPT) was performed to evaluate the location and areal extent of waste areas on the WDI site. Results of the CPT survey provided a rapid, continuous profile of soil characteristics with depth at discrete locations. Each sounding consisted of pushing a 36 mm diameter cone into soil to the approximate depth of 35 feet and electronically measuring the tip resistance and side friction. Buried drilling mud, drilling cuttings, loose or soft fills, or waste materials are characterized by low tip resistance and side friction. The penetration was set at 2 cm/sec, following the provisions of the American Society of Testing Materials Standards (ASTM D3441-75T).

Approximately four CPT soundings per waste handling area (24 total soundings) were conducted to identify the general locations and depths of each area. Upon completion of CPT logging, a field analysis and interpretation of the data was conducted. Final interpretation of all data acquired during this work included an interpretation of the depth, relative soil density and strength, and a preliminary estimate of the horizontal extent of WDI waste handling areas (see the WDI Soil Characterization Report, May, 1989).

### 2.3 AMBIENT AIR MONITORING

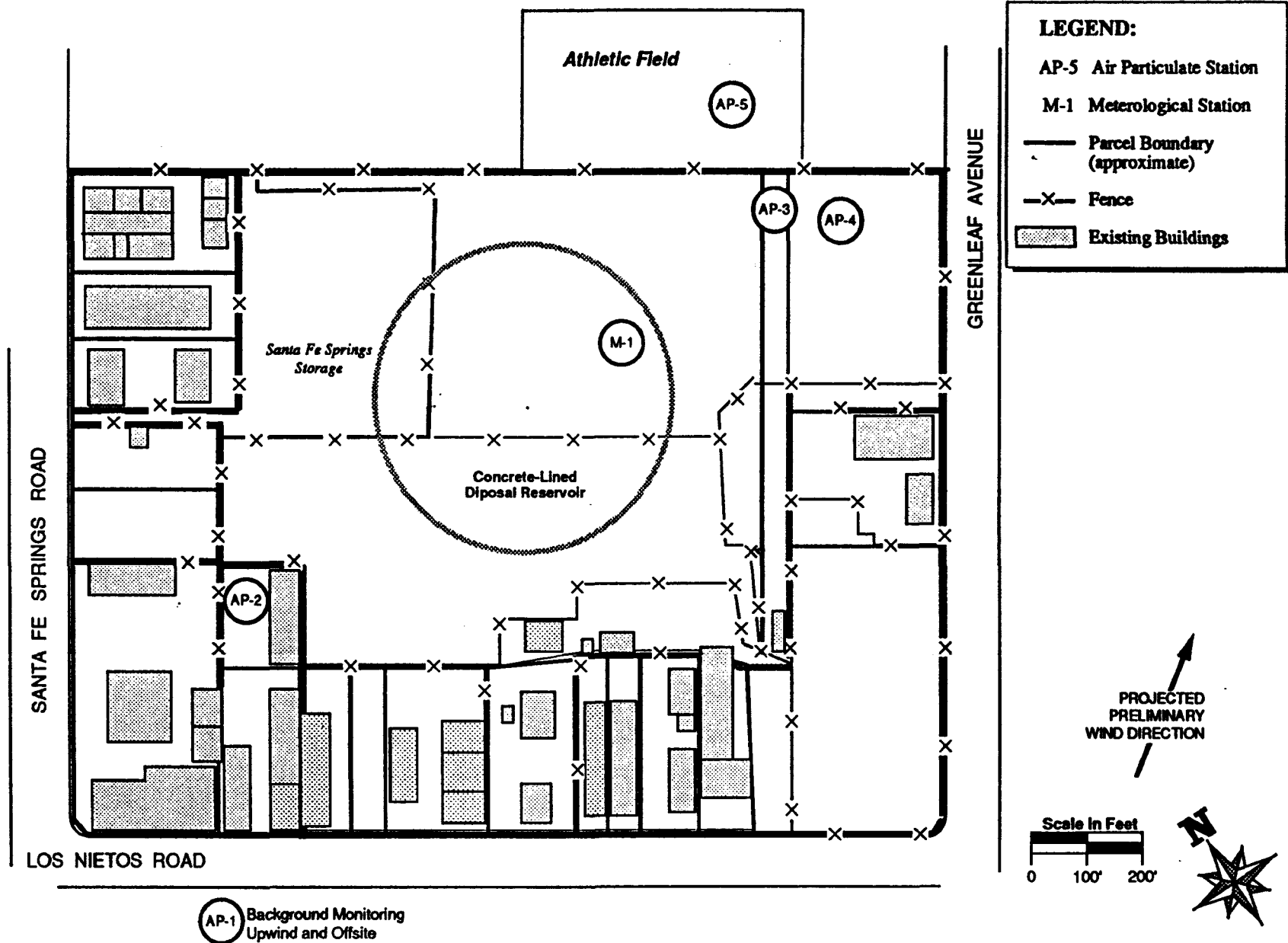
Ambient air sampling was done during the RI activities at the WDI site since the potential to generate particulate matter emissions was present. Emissions as a result of disturbing area soils during drilling operations and from vehicular traffic on unpaved areas of the site was possible. To assess these potential particulate emissions, an ambient monitoring network which included a meteorological station and particulate monitors was established.

The air sample locations were set based on the need to identify baseline conditions and additions to the background particulate levels due to the RI field activities. The data obtained from air monitoring was used for qualitative purposes in assessing airborne dust.

The ambient air sampling network for the WDI site consisted of five (5) high volume total suspended particulate (TSP) air samplers and one (1) meteorological station. The high volume TSP samplers were placed at four perimeter locations: three collection locations were comprised of one sampler each; while the fourth used for checking the reproducibility of data, consisted of two samplers operating simultaneously (Figure 2-1). Based on preliminary wind direction and average wind speed data from a meteorological station located approximately 10 miles upwind from the WDI site, the following rationale was used for placing the ambient air monitors:

- o High volume sampler AP-1 was placed upwind of the WDI site to assess background ambient TSP levels. The sampler was situated on a 30-foot high roof at or near 9831 Romandel Avenue, which was approximately 300 feet west of the site. This location represented the tallest building in the area, thus avoiding potential problems associated with nearby building effects. The monitor was situated at least 2 meters from any walls or parapets on the roof in compliance with EPA Monitoring Guidelines. In addition, the monitor was not placed near any roof ventilator that could disturb the results by emitting particulate matter.
- o High volume sampler AP-2 was situated so that ambient onsite TSP levels could be monitored. The monitor was located on the roof (approximately 15 feet high) of the C & E Die and Fabric shop at 12637-B Los Nietos Road in a location 2 meters from any obstruction. This location was directly adjacent to the westernmost unpaved area of the site.
- o Initially, high volume samplers AP-3 and AP-4 were both located at the eastern site boundary. This location was expected to have the greatest potential for particulate impacts during field investigations since it was directly downwind of the major non-paved area of the site. The samplers were installed such that the inlets were within the breathing zone about 1-5 meters above ground level. The samplers were placed away from any physical obstacles (trees, buildings, etc.) to avoid any airflow disturbances. Following the

Figure 2-1  
**HIGH VOLUME AIR PARTICULATE MONITORING  
 STATIONS**  
 Waste Disposal, Inc.



first week of sampling, sampler AP-3 was relocated adjacent to the other samplers for purposes of confirming reproducibility of data on a weekly basis. Its position next to each of the other 4 samplers was rotated for this purpose in a clockwise direction on a weekly basis. AP-4 will yield data that is representative of residential exposure.

- o High volume sampler AP-5 was situated on a roof about 20 feet high on St. Paul High School at least 2 meters away from any obstruction. This monitoring site was chosen since it was a sensitive receptor location and was downwind of the WDI site. Also, the sampler was placed in a secure location with readily accessible electricity, and was protected from vandalism. The data collected at this location would be representative of residential exposure to particulates in the area.
- o The meteorological station M-1 was installed on the 10-meter tower in the center of the open field portion of the WDI site. This location represented the highest ground elevation at the site, and was generally above any structures in the vicinity. The location of the meteorological station was selected in accordance with the EPA Guideline separation distance of 10 times the height of the structure which would cause the disturbance.

Details of the methods used to collect the air particulate samples are provided in the Field Sampling Analysis Plan. There were 255 air filters collected for 385 non-CLP analyses. Also, 207 filters were collected for gravimetric analysis based on one filter from each of four samplers over a 72-day period (6 days baseline, 66 days sampling). Of these, 52 filters were analyzed for metals and 53 filters analyzed for semi-volatiles, pesticides and PCBs. In addition, 48 filters were collected from the co-located sampler AP-4 for gravimetric analysis; 12 of these filters were analyzed for semi-volatiles and 13 of these filters were analyzed for metals.

The objective of this sampling was to evaluate the quantity and chemical nature of particulates prior to and during intrusive field operations. Prior

to intrusive field operations, TSP sampling was conducted continuously, 24 hours per day, for six (6) days to establish baseline conditions. TSP sampling was also conducted continuously, 24 hours per day, during each work week (6 day period) of field operations.

All TSP filters which were collected during baseline and operational conditions were analyzed gravimetrically, in accordance with CFR Title 40 Part 50, Appendix B, by a non-CLP lab. In addition, TSP filters from the 6-day baseline sampling and the first week (6 days) of field operations were analyzed on alternate days for inorganics and semi-volatile organics, including pesticides and PCB's. For example, on days 1, 3, and 5 the filters were analyzed for metals and on days 2, 4, and 6 for semi-volatile organics.

Semi-volatile analyses were done by extracting the filters with dichloromethane prior to analysis using EPA Method 625 (GC/MS) methodology. Metals analyses were done by digesting the filters with nitric acid prior to analysis by EPA Method 6010. Once the organics were extracted and the metals digested, the extractant and digestate were analyzed in accordance with currently accepted procedures for Methods 625 and 6010. The only modifications to EPA Methods 625 and 6010 were that filters and not water samples were being analyzed.

Initially, the samples were collected and analyzed every other day but since no significant elevations of chemical parameters were observed, the frequency of chemical analysis was reduced to once per week.

Concurrent with the air sampling program, meteorological data was collected continuously using a Climatronics F-460 system. Meteorological data that were collected included wind speed, direction and occurrence, and temperature.

## 2.4 SOIL INVESTIGATION

The RI soil characterization efforts at WDI were designed to evaluate the nature and extent of subsurface soil contamination. The major soil characterization program components are as follows:

- o One hundred (100) soil borings were drilled to the depth of 35 feet at specified locations around the WDI site;
- o Soil samples were collected at these borings, evaluated for lithologic interpretations and submitted for laboratory analysis; and
- o Laboratory results were analyzed later to evaluate the nature and extent of subsurface soil contamination.

The following sections describe the specific details of the field implementation of this program.

#### 2.4.1 Soil Boring Locations and Drilling Specifications

Initially, the soil borings were located in known or suspected waste disposal areas based on an approximate 100-foot-square grid spacing. Borings in all other areas were located using a grid with 150- to 300-foot spacing.

After some adjustment to remove borings which were too closely spaced because of overlapping grids, or borings which were too tightly clustered to be justified by suspected patterns of contamination, one hundred (100) boring locations were selected (Figure 2-2, Table 2-2). Of these borings, approximately thirty-seven (37) were drilled in areas where the operation of unlined waste handling areas occurred. Some borings were located outside of these areas to evaluate whether contaminants have migrated beyond the area boundaries.

The following provides the rationale for locating borings outside the WDI's waste handling areas:

- o Twelve (12) soil borings were drilled around the outermost perimeter of the WDI site to evaluate whether or not any waste has extended beyond site boundaries and to evaluate if contamination has migrated offsite;



Figure 2-2  
SOIL BORING LOCATIONS  
Waste Disposal, Inc.

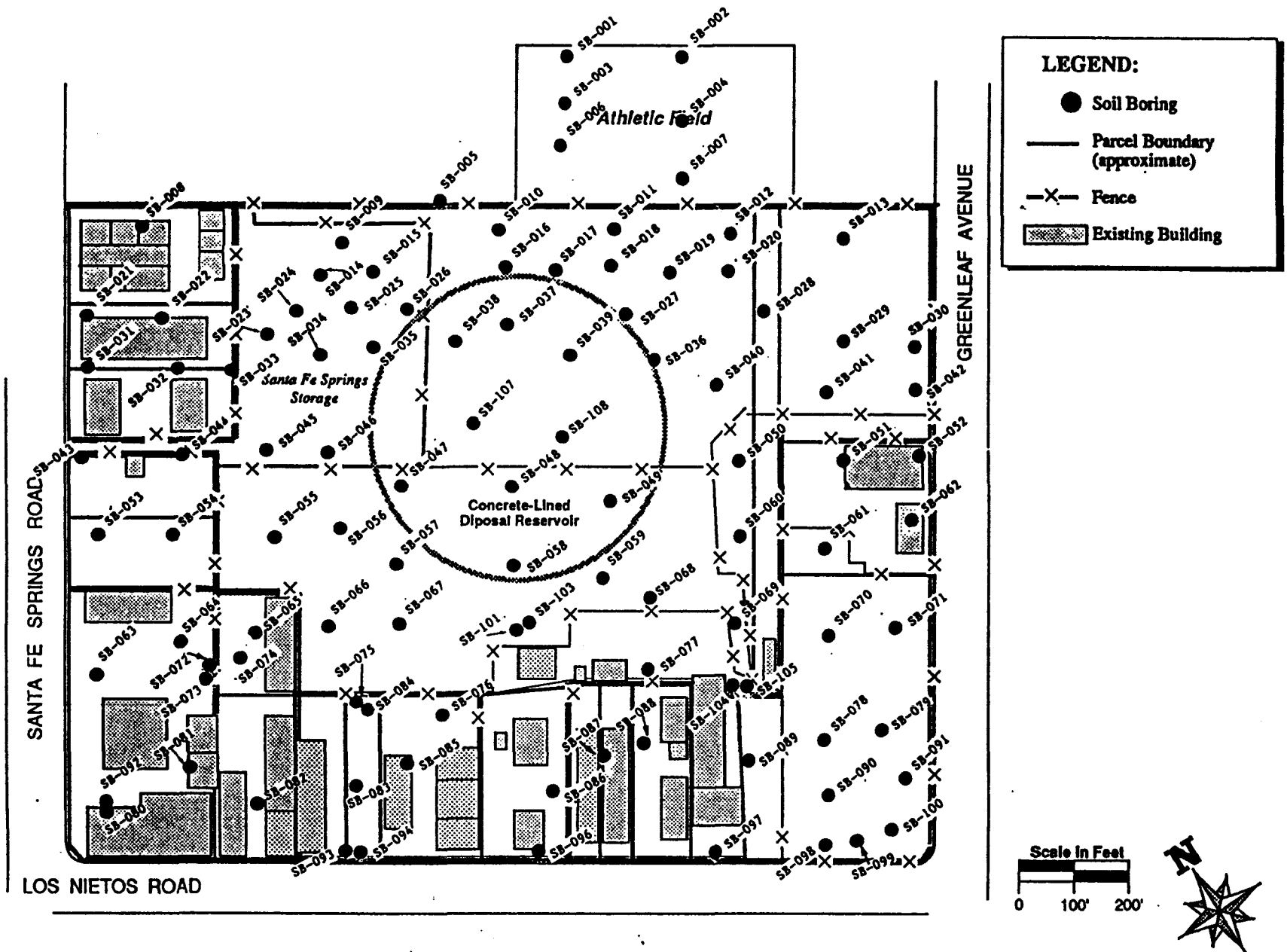


TABLE 2-2

SPATIAL DISTRIBUTION/DEPTH OF SOIL BORINGS  
WASTE DISPOSAL, INC.

Area	Number of Borings	Depth of Borings (ft)
Athletic Field	6	6-35 <sup>a</sup>
Waste Handling Areas	37	15-79 <sup>b</sup>
Reservoir	13	35
Los Nietos Road Small Businesses	8	35-131.5 <sup>c</sup>
Toxo Spray Dust Property	5	35-115 <sup>c</sup>
Campbell Property	6	35
Sleek Craft Boats Property	4	35
Site Perimeter	12	35-96 <sup>b</sup>
Other	9	35
TOTAL	100	--

<sup>a</sup> Two of the 6 borings on the high school athletic field were drilled to a depth of 35 feet. The remaining 4 borings were drilled to a total depth of 11.5 feet.

<sup>b</sup> If borings within the waste disposal areas encountered free liquids they were completed as liquid recovery wells (depth 15-25 ft). If free liquids were not encountered, borings were terminated at 35-50 ft depth (depending upon vertical extent of contamination).

<sup>c</sup> Borings to be made into subsurface gas wells were terminated at 35-55 ft (depending upon vertical extent of contamination). Borings to be made into groundwater wells were terminated at 60-130 ft, depending on the aquifers to be sampled.

- o Ten (10) soil borings were drilled in areas where the presence of soil contamination due to past waste disposal activities or contaminant migration from nearby sources was neither confirmed nor denied by existing records;
- o Thirteen (13) soil borings were drilled within the concrete reservoir to evaluate the nature and extent of cover material on the reservoir, and waste material within the reservoir;
- o Eight (8) soil borings were drilled adjacent to the small businesses along Los Nietos Road, five (5) were drilled on the Toxo Spray Dust and Campbell properties, and four (4) were drilled adjacent to Sleek Craft Boats; the purpose of these borings was to evaluate the nature and extent of any soil contamination present in these areas as a result of WDI operations or more recent activities; and
- o Six (6) soil borings were drilled on St. Paul High School athletic field to evaluate if any contaminants from the WDI site had migrated onto this area via overland surface runoff.

Soil borings were drilled with a 6-inch hollow-stem auger. Borings that were to be converted to groundwater monitoring wells were drilled with a 10-inch hollow-stem auger. Of the six (6) borings drilled on the high school athletic field, two (2) were approximately 6 feet deep. All other borings on the site averaged about 35 feet total depth below ground surface but some borings were completed just above groundwater.

#### 2.4.2 Soil Sampling Procedures

Soil samples were collected during drilling operations with a split-spoon sampler. The split-spoon sampler was lined with stainless-steel tubes 2.5 inches in diameter. The soil sample contained in each liner was trimmed, covered with aluminum foil and capped with a plastic cover. Soil samples were collected once every 5 feet and at lithologic changes. A minimum of 3 samples per boring were kept for laboratory analysis. After lithologic interpretation, the remaining samples were stored in drums along

with the soil cuttings. Samples were collected for chemical analysis at each location where contamination was visibly present. Generally, one sample from near the surface and/or in the middle of each waste handling area, one sample at mid-depth and/or at the bottom of each waste handling area, and one sample at the bottom of each disposal area, the "clean area" immediately below each waste handling area was collected. If no contamination was observed in a boring, the deepest sample from that boring was submitted for chemical analysis.

Field lithologic logs of all borings including the following information were kept:

- Physical characterization and grain size distribution of sample
- Stratigraphic boundaries
- Presence of any visible contaminants
- Details relevant to split-spoon sampling
- Color changes
- Moisture content
- Groundwater elevation
- Thickness of individual units
- Any other conditions encountered during drilling  
(i.e., changes in drilling rate, etc.)

Field screening of soil samples was conducted to assign a designation as high, medium or low concentration. This designation which determined the detection limits used by analytical laboratories, was based on visual observation, Organic Vapor Analyzer (OVA) and/or photoionization detector (HNU). A "high level" sample was defined as any sample with:

- o Visible contamination
- o Over 100 percent of the LEL on the explosimeter
- o Over 1,000 parts per million reading on the OVA
- o Over 20 parts per million reading on the HNU.

A "medium level" sample was defined as any sample with at least two (but not all) of these characteristics. A "low level" sample was defined as a sample with no more than one of these characteristics.

### 2.4.3 Soil Analytical Methods

All soil samples were analyzed for the Target Compound List (TCL) plus molybdenum (see Appendix B). The methods and quantification limits as specified by the CLP SOW for TCL organics and inorganics, and the methods and quantification limits specified by SW-846 for molybdenum were used. Approximately 35 percent of all soil samples were analyzed utilizing CLP laboratories and 65 percent of all soil samples were analyzed for volatiles, semi-volatiles, pesticides/PCBs, and metals using non-CLP laboratories. Both CLP and non-CLP data was validated in accordance with Section 10.0 of the WDI QAPP, Revision 2 (Ebasco 1988b).

Approximately 5 soil samples were also tested by non-CLP laboratories for geotechnical parameters such as grain size (ASTM D422), clay fraction (ASTM D422-63), porosity (ASTM D4612), cation exchange capacity (EPA Method 9080), and permeability (ASTM D2434-68). The results of these analyses are presented in Appendix B and will be used to supplement available data for transport-fate analysis, and to provide information for treatability studies.

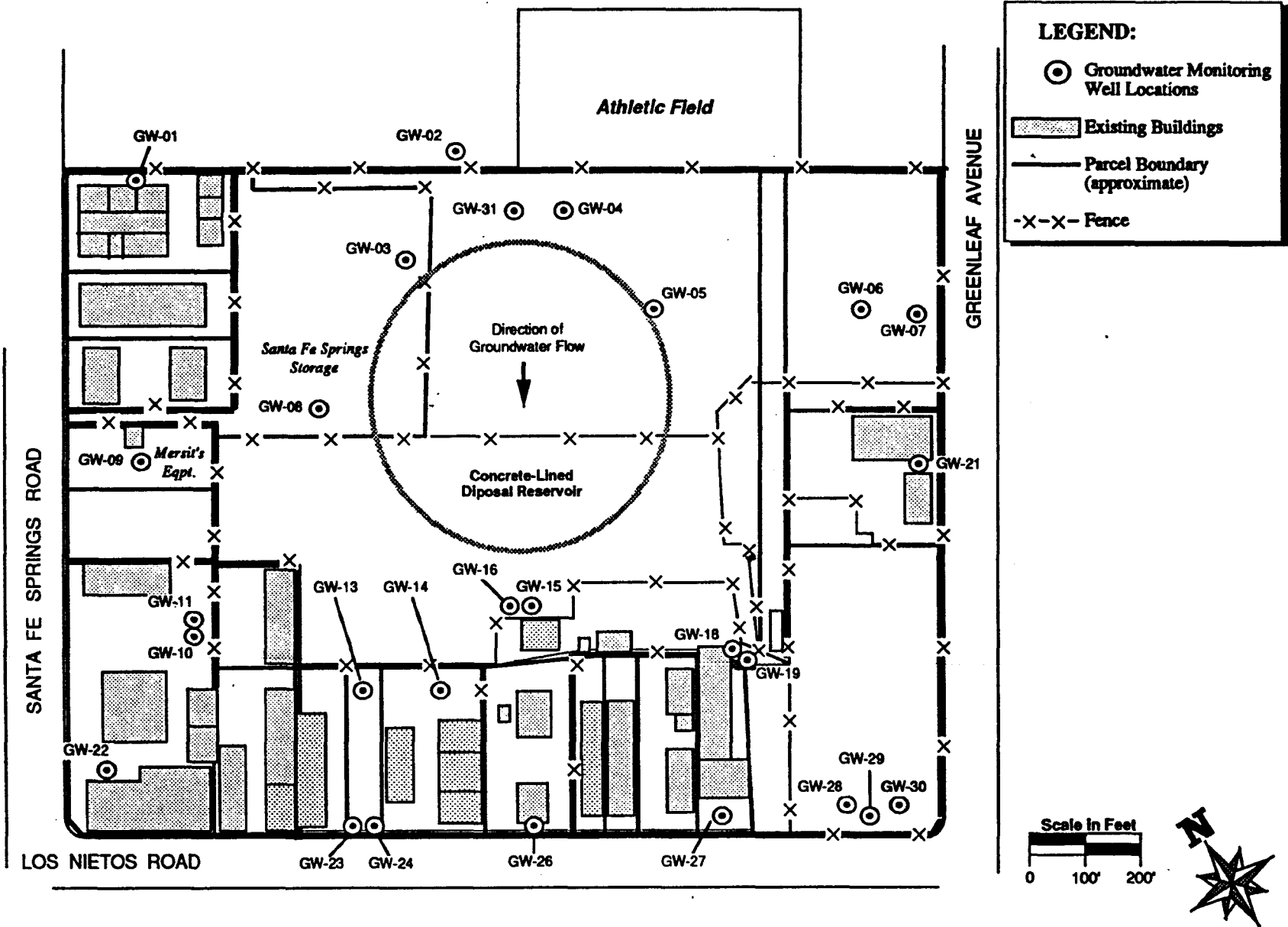
In addition, three (3) samples were analyzed by non-CLP laboratories for asbestos using plane polarized-light microscopy in accordance with EPA Interim Method for Determination of Asbestos in Bulk Samples. Asbestos fibers were not observed in these three samples.

## 2.5 GROUNDWATER INVESTIGATION

A groundwater investigation was included as part of the remedial investigation. This investigation was designed to assess the nature and extent of any groundwater contamination. The major components of this program include the following:

- o Twenty seven (27) groundwater monitoring wells were installed at specified locations around the site (Figure 2-3);
- o Water levels at these monitoring wells were measured to evaluate the groundwater flow direction; and

Figure 2-3  
GROUNDWATER MONITORING  
WELL LOCATIONS  
Waste Disposal, Inc.



- o Water samples were collected from these wells and submitted for laboratory analysis and the results were used later to assess the nature and extent of groundwater contamination.

The details of the groundwater investigation activities are provided below.

#### 2.5.1 Well Locations, Design and Construction

Of the one hundred (100) soil borings that were drilled during WDI remedial investigation activities, twenty seven (27) borings were drilled using a 10-inch auger and were converted into groundwater monitoring wells (Figure 2-3, Table 2-3).

Six wells including GW-01, GW-02, GW-07, GW-22, GW-26 and GW-29 were the first to be installed at the WDI site. These wells were located around the site perimeter and were used to estimate the local groundwater gradient and direction of flow. Once this information was determined, the remaining twenty one (21) wells were installed downgradient of potential sources of groundwater contamination. The deep wells, GW-12, GW-17, GW-20 and GW-25, proposed in the FSAP, were not installed because sampling of wells during Phase I field investigations indicated that deep penetration of groundwater by WDI contamination may not have occurred.

The design and construction of the monitoring wells were in accordance with the general guidelines for monitoring well installation as described in the WDI Field Sampling and Analysis Plan, Revision 2, Section 4.2.2 (Ebasco 1988) and REM III Field Technical Guideline FT-7.01.

Of the 27 groundwater monitoring wells installed, twenty one (21) were shallow wells designed to sample the uppermost aquifer. These wells were completed at the water table to a depth of approximately 55-70 feet (Figure 2-4). This allowed for a 20-foot screen, with approximately 10 feet above the saturated zone and 10 feet below. The purpose of this design was to allow for the sampling of any possible free-floating contaminants on top of the water table, as well as dissolved-phase contaminants below the water table and to obtain groundwater elevation and flow information.

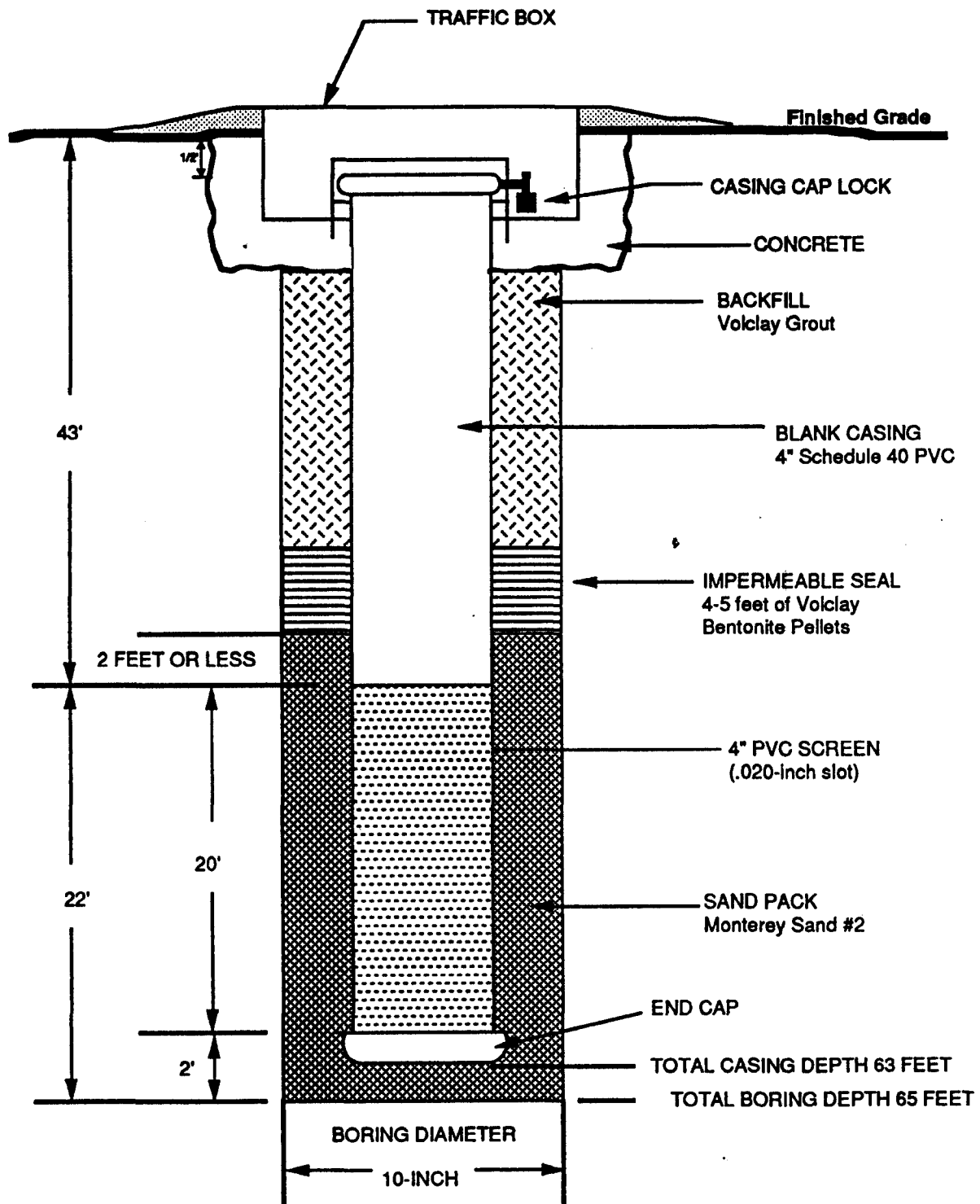


Figure 2-4  
Design of Typical  
Groundwater Monitoring Well  
Assumed Boring Depth 65 Feet  
Waste Disposal, Inc.



TABLE 2-3  
GROUNDWATER MONITORING WELL LOCATIONS AND DESIGN SPECIFICATIONS

Location	GW Well Number	Soil Boring Number	Boring Depth (feet)	Well Depth (feet)	Screen Length (feet)	Imp. Seal Thickness (feet)	Depth to Groundwater (feet)	Surface Elevation (feet above msl)	Well Type	Date
B&L Engineer	GW-01	SB-008	60	58	20	4.5	48	149.61	Shallow	9/16/88
Fedco Dist. Center	GW-02	SB-005	55	53	20	4.5	41	153.76	Shallow	9/15/88
RV Storage	GW-03	SB-026	70	68	20	4.5	63	167.76	Shallow	10/19/88
Reservoir	GW-04	SB-017	70	68	20	4.5	58	167.01	Shallow	9/26/88
Reservoir	GW-05	SB-036	65	63	20	4.5	59	166.92	Shallow	10/03/88
Reservoir	GW-06	SB-029	66.5	63	20	4.5	50	158.63	Shallow	9/13/88
Reservoir	GW-07	SB-030	60	58	20	4.5	49	154.78	Shallow	9/14/88
RV Storage	GW-08	SB-046	65	63	20	4.5	57	163.63	Shallow	10/19/99
Mersit's Equipment	GW-09	SB-054	60	58	20	4.5	50	153.77	Shallow	10/13/99
Dia-Log	GW-10	SB-073	130	128	10	4.5	49	154.98	Intermediate	9/29/88
Dia-Log	GW-11	SB-072	60	58	20	4.5	49	154.91	Shallow	9/25/88
Toxo Spray Dust	GW-13	SB-075	60	59	20	4.5	53	157.77	Shallow	10/07/88
Terry Trucking	GW-14	SB-076	60	58	20	4.5	52	157.92	Shallow	10/18/88
Reservoir	GW-15	SB-103	70	68	20	3.0	57	163.55	Shallow	10/12/88
Reservoir	GW-16	SB-101	79	79	5	4.5	55	163.32	Intermediate	10/17/88
H&H Contractors	GW-18	SB-104	74	74	5	4.5	54	159.34	Intermediate	10/14/88
H&H Contractors	GW-19	SB-105	60	58.5	20	4.5	54	159.16	Shallow	10/14/88
Atlas Heat Treating	GW-21	SB-062	60	65	20	4.5	48	155.49	Shallow	10/01/88
Dia-Log	GW-22	SB-092	80	78	20	4.5	68	156.94	Shallow	9/23/88
Toxo Spray Dust	GW-23	SB-093	65	63	20	4.5	58	157.23	Shallow	10/04/88
Toxo Spray Dust	GW-24	SB-094	115	113	10	4.5	58	157.03	Intermediate	10/05/88
Timmons Wood	GW-26	SB-096	66.5	63.5	20	4.5	53	156.29	Shallow	9/20/88
Rick's Smog Service	GW-27	SB-097	66.5	63	20	4.5	49.5	157.28	Shallow	9/22/88
Campbell Property	GW-28	SB-098	66.5	63.5	20	4.5	49.5	157.56	Shallow	9/19/88
Campbell Property	GW-29	SB-099	65	64	20	4.5	49.5	157.69	Intermediate	10/06/88
Campbell Property	GW-30	SB-100	96	93.5	20	4.0	86	157.01	Deep	10/26/88
Reservoir	GW-31	SB-016	65	63	20	4.5	58	167.47	Shallow	10/03/88

Note: The deep wells, GW-12, GW-17, GW-20 and GW-25, were not drilled because deep penetration of groundwater contamination was not expected.

Four double-well clusters were installed. Each double-well cluster consisted of a shallow well and an intermediate well (Figure 2-5). The shallow wells were constructed similar to the other wells on the site to the approximate depth of 60-70 feet. The intermediate wells were completed immediately above the first clay layer, below the water table. The depth of the intermediate wells ranged from 74-130 feet.

One triple well cluster was installed. The triple-well cluster included a shallow well, an intermediate well and a deep well (Figure 2-6). The shallow well was installed 65 feet below ground surface and was similar in construction to other shallow wells on the site. The intermediate well was completed immediately above the first clay layer below the water table (approximate depth 70 feet). The deep well penetrated this clay layer and was completed immediately below it.

In general, the intermediate wells were designed to sample denser contaminants such as halogenated hydrocarbons which may have sunk to the top of the first clay layer. The deep well was designed to sample dissolved-phase contaminants beneath this clay layer. All wells in double- and triple-well clusters were installed in separate borings. All PVC well casings were steam cleaned and rinsed with deionized water prior to installation in the boreholes.

The installation of shallow and intermediate monitoring wells was conducted in accordance with the following general procedure:

- o Well depths were set by the rig geologist based on the stratigraphic log developed from the analysis of samples taken at 5-foot intervals and also the location of the water table at the particular boring.
- o Soil samples from at least three different depths above the water table were kept for chemical analysis.
- o The well was advanced to the chosen depth with a 10-inch O.D. (outside diameter) hollow-stem auger.

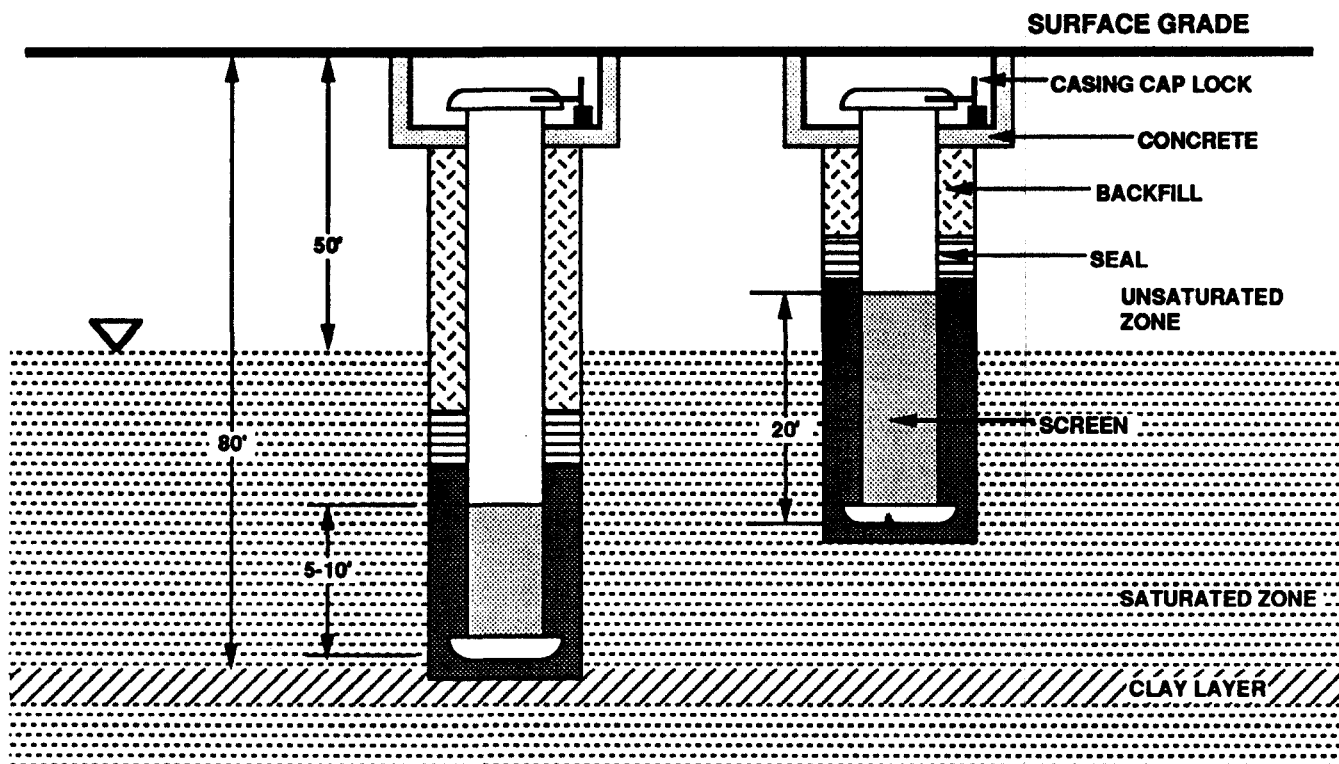


Figure 2-5

**DESIGN OF TYPICAL  
DUAL WELL CLUSTERS**  
Waste Disposal, Inc.

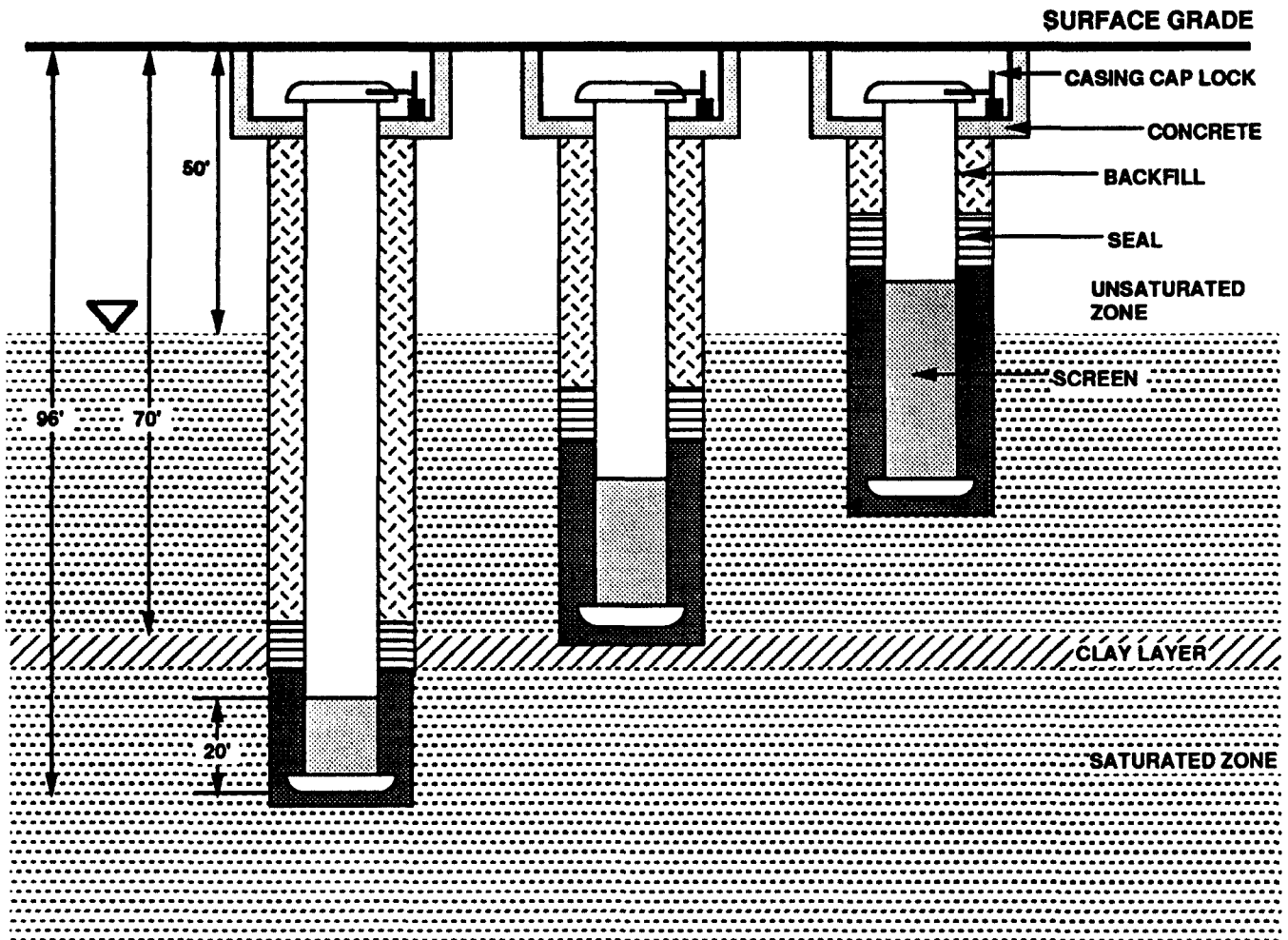


Figure 2-6  
**DESIGN OF TYPICAL  
 TRIPLE-WELL CLUSTERS  
 WASTE DISPOSAL INC.**

- o Blank casing was installed flush above the water table and threaded to 20 feet of .020-slot PVC screen. This screen and casing was set at the bottom of the borehole through the middle of the hollow-stem auger. The screen bottom was plugged.
- o Auger flights were removed from the borehole one section at a time to keep the formation from caving.
- o The annular space between the PVC and boring wall was backfilled from the bottom of the well to at least 2 feet above the top of the PVC screen with Monterey No. 2 sand. A 4- to 5-foot volclay bentonite seal was placed on the sand, and the remaining annular space was backfilled with volclay grout mixture.
- o Blank casing above the land surface was sawed and filed to fit within a traffic box flush with the existing grade.
- o A casing cap, protective locking cover, and a traffic box were installed for each well.
- o A 3- to 4-foot-diameter cement pad was created around the traffic box and sloped in such a way as to direct surface runoff away from the casing.

The procedure followed in installation of the deepest well of the triple-well cluster was as follows:

- o The well was drilled with an air rotary rig until a layer of clay or low permeability silt and clay was identified (approximate depth 96 feet). A 10-inch O.D. steel conductor casing was driven down the borehole to keep the formations from caving. The casing was pushed into the clay layer. The annular space between the conductor casing and the borehole wall was filled with grout mixture and allowed to set. The interior of the conductor casing was filled with grout approximately 1-2 feet above the clay and allowed to set. A smaller diameter (8-inch O.D.) conductor casing was driven through the

bottom of the first casing until the desired depth was reached. A 4-inch O.D. PVC casing with 20 feet of .020-slot screen was set inside the 8-inch O.D. conductor casing.

- o The 8-inch conductor casing was gradually removed from the borehole as the annular space outside the PVC casing was backfilled from the bottom of the well to at least 2 1/2 feet above the top of the PVC screen with graded, clean Monterey No. 2 sand. A 4-foot bentonite seal was placed on the sand, and the remaining annular space was backfilled with volclay grout mixture to approximately 7 feet below ground surface.
- o Blank casing above the land surface was trimmed and capped.

A complete set of well installation reports has been included in the WDI Groundwater Characterization Report (May, 1989).

#### 2.5.2 Groundwater Sampling Procedures

The monitoring wells were developed after construction to clear the well screen and sandpack of fine materials that could possibly clog the screen slots reducing the effectiveness of the well. All monitoring wells were developed by bailing, surging and pumping in general accordance with REM III Field Technical Guideline FT-7.01. A summary of information regarding well development operations performed at different wells is provided in Table 2-4. The pH, temperature and electrical conductivity values in this table represent the measured values of these parameters at completion of well development operation.

An Organic Vapor Analyzer (OVA) was used to evaluate if high concentration of volatile organic vapors were present in the well. The OVA probe was held inside the well casing within the upper three feet. If the OVA reported a reading greater than 5 ppm, a full-face respirator was used during the well development operation. Once completed, a water level sounder was used to measure the depth to groundwater. This was done by the measuring probe down the hole. A sounding device and a red light located on the water level reel were activated upon contact of the probe with water in the well.

TABLE 2-4  
GROUNDWATER MONITORING WELL DEVELOPMENT

Well No.	Depth to GW (feet)	Water Removed by Bailing (gallons)	Water Removed by Pumping (gallons)	Total Water Removed (gallons)	Pumping Rate (gpm)	pH	Temperature (°C)	Electrical Conductivity (uMHOS/cm)	Date
GW-01	46.9	150	90	240	2.0-8.0	7.3	21.7	2,200	11/02/88
GW-02	42.2	150	90	240	2.0-8.0	7.2	21.8	1,740	11/03/88
GW-03	61.1	45	135	180	7.0	7.2	21.2	1,660	10/22/88
GW-04	59.5	250	50	300	2.0-8.0	7.1	20.3	1,940	10/27/88
GW-05	59.8	NA	NA	120	NA	7.0	20.9	2,050	10/28/88
GW-06	51.7	120	120	240	2.0-7.0	7.1	22.1	1,910	10/28/88
GW-07	48.1	180	90	270	NA	7.1	21.6	1,700	10/29/88
GW-08	59.3	45	75	120	2.0-7.0	6.9	22.8	1,780	10/20/88
GW-09	47.5	120	120	240	2.0-8.0	6.9	20.9	1,930	11/01/88
GW-10	49.3	30	54	84	4.0	NA	21.5	1,900	10/03/88
GW-11	49.9	45	207	252	7.0	NA	25.0	1,900	10/03/88
GW-13	51.7	NA	NA	240	2.0-8.0	7.0	21.1	1,800	11/01/88
GW-14	51.8	150	90	240	2.0-8.0	6.9	21.4	1,800	11/01/88
GW-15	57.2	40	80	120	7.0	7.2	20.0	1,700	10/20/88
GW-16	57.3	45	105	150	7.0	7.2	22.5	1,800	10/20/88
GW-18	55.6	40	44	84	7.0	7.2	21.0	1,850	10/17/88
GW-19	54.5	8	76	84	7.0	6.9	24.5	1,950	10/17/88
GW-21	49.7	150	90	240	2.0-8.0	7.1	23.2	2,000	10/29/88
GW-22	64.9	30	54	84	7.0	NA	22.5	1,770	10/03/88
GW-23	59.4	20	NA	20	NA	6.7	23.7	2,010	10/31/88
GW-24	64.4	120	240	360	2.0-8.0	7.2	23.0	2,070	10/31/88
GW-26	51.4	35	49	84	7.0	NA	24.9	1,850	10/02/88
GW-27	51.8	40	86	126	7.0	NA	22.0	1,800	10/02/88
GW-28	53.80	NA	NA	55	NA	NA	21.5	1,820	10/02/88
GW-29	52.4	150	90	240	2.0-8.0	7.0	22.0	1,920	10/29/88
GW-30	55.4	NA	NA	550	8.0	7.3	21.0	1,460	11/15/88
GW-31	60.0	NA	NA	180	NA	7.2	19.6	1,740	10/27/88

Note: N/A = Data was not available.

The possibility of floating hydrocarbons was evaluated by using hydrocarbon indicator paste on a measuring tape. The paste is designated to turn from pink to yellow upon contact with hydrocarbon products. The coated tape was lowered below the top of the water table to detect any free-floating contaminants.

In addition to using the indicator paste a sample of groundwater was taken from the top of the water table with a clear translucent teflon bailer for visual detection of any possible free hydrocarbon.

The well was developed once it was determined that no floating hydrocarbons were present. A 15-foot, 3.50-inch, bottom-filling steel bailer, operating on the back of a development truck was used to remove stagnant water and large soil particles and sediments from the wells. After removing about 10 gallons of water with this bailer, a 3.50-inch surge block, installed at the bottom of a galvanized pipe consisting of a block, was used to agitate the well water to break up material that may have been smeared on the surrounding formation. This operation helped to stabilize the formation materials near the screen sections. The bailer was then used again to remove the well water. The surging and bailing operation was repeated 2-3 times until water in the well was relatively free of large sediment particles. The total volume of water removed at the end of this stage of operation was approximately 50-100 gallons.

After the extracted water appeared to be free of sediment, a 3-inch stainless steel submersible pump, with discharge rate of up to 15 gallons per minute, was lowered into the well and pumped until at least three to five casing volumes were removed.

During well development, samples of groundwater were taken periodically and measured for turbidity, pH, temperature and electrical conductivity. The stabilization of these parameters was another criterion used to determine the completion of well development. If the well did not produce sufficient water, a stainless steel bailer was used instead of the pump for removal of water.



Groundwater elevations were measured at all monitoring wells using an electric water level sounder (at least 24 hours after completion of well development). The water sensor probe attached to the measuring tape was lowered into the well as discussed earlier. Measurements were made to the top of the PVC well casing within  $\pm 0.01$  foot level of accuracy. For consistency and accuracy of subsequent measurements, the side of the casing which was used to measure the depth-to-water was marked.

Depth-to-water measurements were converted to elevation-of-water-table values after the elevation of the ground surface, the tops of traffic boxes and the tops of well casings were surveyed. Water level elevation was used to determine the gradient and direction of groundwater flow.

Groundwater sampling methods and documentation were conducted in accordance with REM III Field Technical Guideline FT-7.02 as described in Section 6.1.3 of the WDI FSAP Revision 2 (Ebasco, 1988). Samples from each well were collected with a set of two 3-foot stainless steel bailers. The two bailers were, respectively, 1.625 and 2.375 inches in diameter. Three sets of two bailers were decontaminated and available each day for sampling. The 1.625 inch bailer was used to collect the samples for volatile organics. This bailer was lowered into the well slowly to avoid any sudden impact that could cause the release of organic vapors. Once the bailer was filled with water, it was pulled out of the well. A clean teflon bottom-emptying valve was installed at the bottom of bailer and water from the bailer was poured through this valve into two 40 ml glass vials. Care was taken to ensure sample vials were free of air bubbles.

The remaining samples for semi-volatile organics, pesticides/PCB's and metals were collected with a 2.375-inch bailer. The bailer was used as described above to collect water from the well. The water was poured from the bailer into four 1-liter amber glass bottles for semi-volatile organics and pesticides/PCB's and into a 1-liter polyethylene bottle for metals. Each sample was filled with water directly from the same bailer without filtration to preserve the sample integrity. In total, five 1-liter samples were collected from each well, two samples for semi-volatile organics, two samples for pesticides/PCB's and one sample for metals.

### 2.5.3 Groundwater Analytical Methods

Groundwater samples collected from on-site wells for CLP analysis are as follows:

- o Twenty seven (27) sets of samples were collected for TCL organic and inorganic analysis. This number corresponds to collection of one set of samples from each of 27 monitoring wells;
- o Eight (8) sets of samples were collected as equipment blanks. As indicated before, one set of equipment blank samples was collected in each sampling day.
- o Two (2) sets of samples were collected from GW-09 and GW-19 as duplicates; and
- o Two (2) sets of samples were collected from GW-22 and GW-28 as lab QC samples.

Groundwater samples collected from off-site wells include:

- o Two (2) sets of samples were collected from the wells, OS-01 and OS-04, for TCL organic and inorganic analysis. These wells were located approximately one mile to the northeast and to the northwest directions from the site.
- o One set of samples was collected from OS-01 as duplicates; and
- o One set of samples was collected from OS-04 as lab QC samples.

The samples were analyzed for the Target Compound List (TCL) as indicated in Appendix B. The analysis of the TCL was a Routine Analytical Service (RAS). The RAS methods and quantification limits were specified by the CLP for the TCL parameters.

## 2.6 SUBSURFACE-GAS INVESTIGATION

A subsurface gas investigation was conducted as part of the WDI RI. Twenty six (26) subsurface gas wells were designed, installed, and sampled to investigate the nature and extent of subsurface gas.

The following sections describe the specific methodologies for this work.

### 2.6.1 Well Locations, Design and Construction

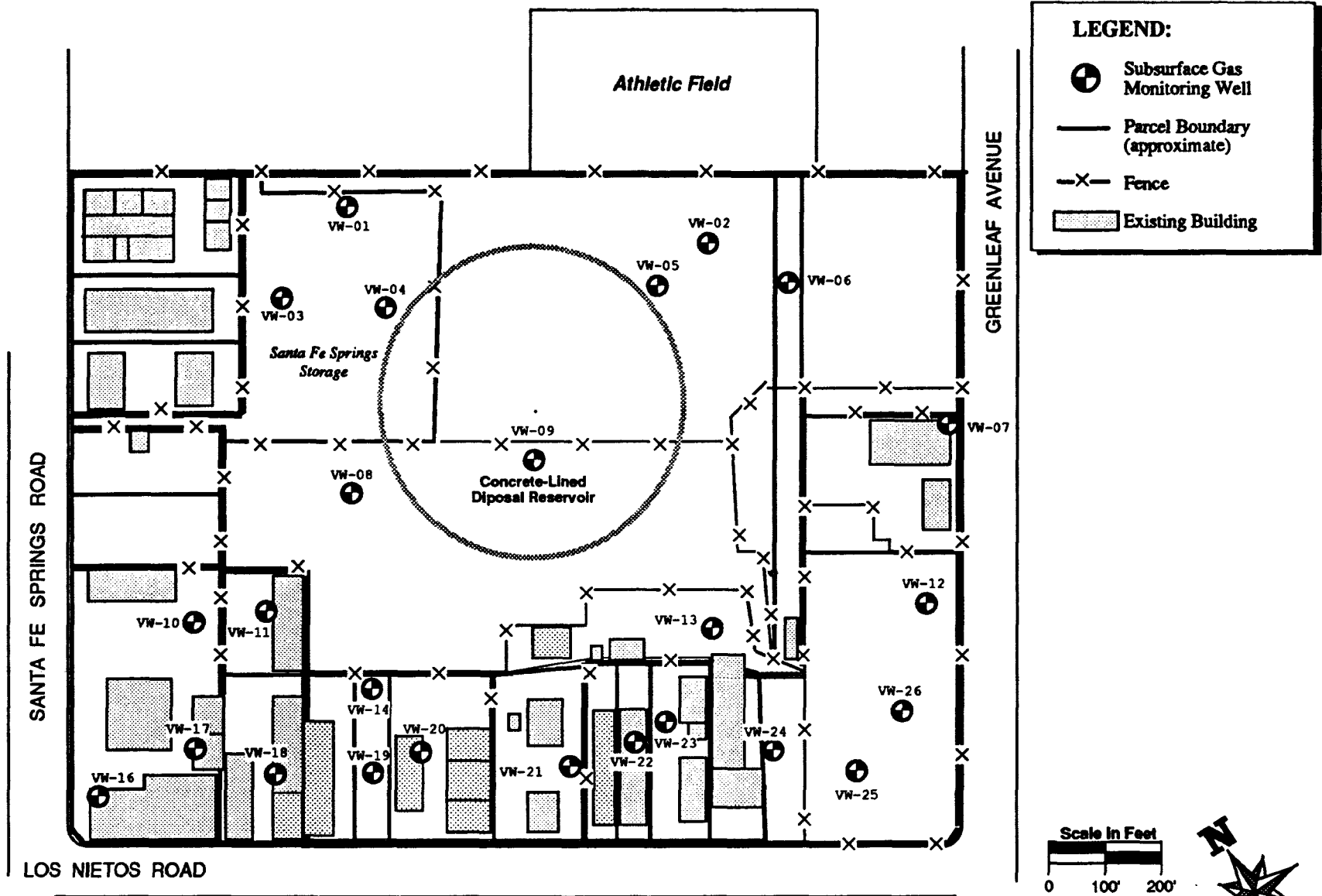
Twenty six (26) soil borings were converted into subsurface-gas monitoring wells. Each well was installed to a depth just below contaminants identified by field data or to a depth of 35 feet. The monitoring wells were drilled using a 6-inch hollow stem auger at locations shown in Figure 2-7 and completed using the design shown in Figure 2-8. \*

The rationale behind the placement of subsurface gas monitoring wells was as follows:

- o Subsurface gas monitoring wells VW-01, VW-02, VW-03, VW-04, VW-05, VW-06, VW-08, VW-10, VW-11, VW-12, VW-14, VW-15, VW-17, VW-19, VW-20, VW-24, VW-25, and VW-26 were installed adjacent to the outermost boundaries of each known or suspected waste disposal area to assess the generation and migration of gas from the disposed wastes or biological breakdown of waste components.
- o Subsurface gas monitoring well VW-09 was installed in the center of the reservoir to assess the generation and migration of gas from the disposed wastes or biological breakdown of waste components.
- o Subsurface gas monitoring wells VW-07, VW-13, VW-16, VW-18, VW-21, VW-22, and VW-23 were installed in areas where the presence of gas was unknown.

The gas monitoring wells were installed using the following procedure:

Figure 2-7  
**SUBSURFACE GAS WELL LOCATIONS**  
 Waste Disposal, Inc.



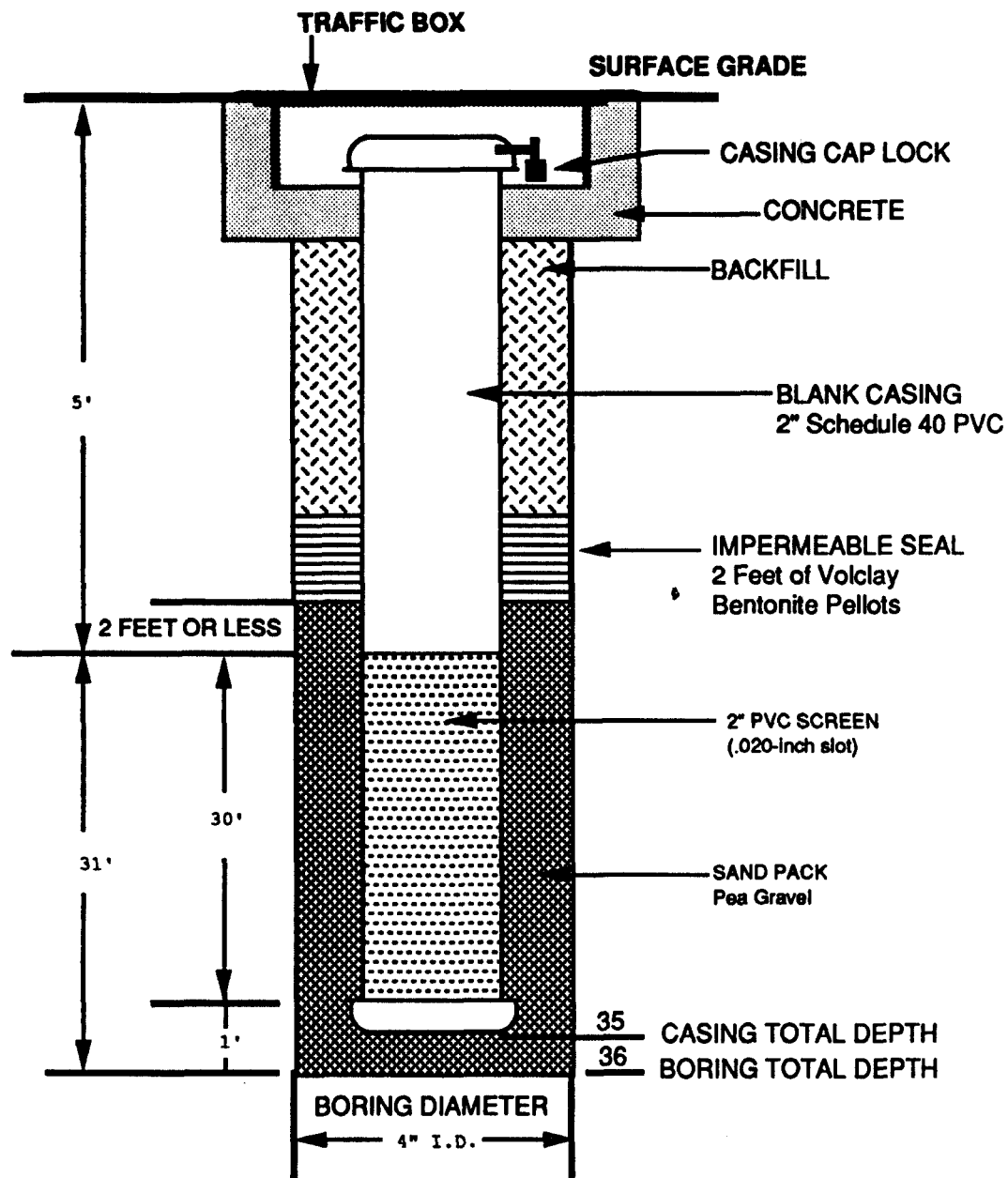


Figure 2-8  
**DESIGN OF A TYPICAL  
 SUBSURFACE GAS  
 MONITORING WELL**  
 Waste Disposal, Inc.  
 Santa Fe Springs, CA

- o Each boring was drilled to a specific depth based on contaminants encountered. Once the depth was reached, 2-inch diameter Schedule 40 PVC with 0.020-inch slot openings casing was installed. The slotted casing was installed below ground surface and flush threaded PVC blank casing was used to complete the casing string which extended to about one foot below the ground.
- o The annular space was backfilled from the well bottom to about 2 feet above the screen top with 5/16-inch diameter pea gravel. An approximate 2-foot bentonite seal was placed on top of the pea gravel and the remaining annular space backfilled with volclay grout.
- o A protective locking cover and traffic box was installed for each well surrounded by a 3-foot cement pad constructed to direct surface runoff away from the casing.

The subsurface gas monitoring well installation reports that describe the details of construction for each well have been included in Appendix A of WDI Subsurface Gas Characterization Report.

#### 2.6.2 Subsurface Gas Sampling Procedures

The subsurface gas sampling was done according to ASTM D1945-81 methods for basic gases and Method 102 and 103 of the ARB guidelines for trace contaminants. Each well was purged initially by a vacuum pump to remove the gases trapped in the well and the source lines. Then, a 3-liter stainless steel cylinder was attached to the pump and filled by representative subsurface gases. At completion of sample collection, each sample was labeled with the relevant information and shipped to the analytical laboratory.

In total, twenty eight samples were submitted for laboratory analysis. Twenty six samples were collected from the monitoring wells and two blank cylinders were also submitted. The blank cylinders were filled using the same procedures outlined above except ambient air was used to fill the cylinders.

### 2.6.3 Subsurface Gas Analytical Methods

The State of California through the Calderon Bill and California Air Resource Board (ARB) Testing Guidelines for Active Solid Waste Disposal Sites address the emissions of gases from solid waste disposal sites. To comply with the promulgated regulations, the subsurface gas samples were analyzed for the following major gases:

- o Oxygen
- o Nitrogen
- o Methane
- o Carbon Dioxide

and the following ARB specified air contaminants:

- |   |              |
|---|--------------|
| o Benzene                                   | $C_6H_6$     |
| o Chloroethene (Vinyl Chloride)             | $C_2H_3Cl$   |
| o 1,2 Dibromoethane (Ethylene Dibromide)    | $C_2H_4Br_2$ |
| o 1,2 Dichloroethane (Ethylene Dichloride)  | $C_2H_4Cl_2$ |
| o Dichloromethane (Methylene Chloride)      | $CH_2Cl_2$   |
| o Tetrachloroethylene (Perchloroethylene)   | $C_2Cl_4$    |
| o Tetrachloromethane (Carbon Tetrachloride) | $CCl_4$      |
| o 1,1,1 Trichloroethane (Methyl Chloroform) | $C_2H_3Cl_3$ |
| o Trichloroethylene (TCE)                   | $C_2HCl_3$   |
| o Trichloroethane (Chloroform)              | $CHCl_3$     |

The sample cylinders submitted to the analytical laboratory were kept at room temperature until being analyzed. Major gases contained in the cylinder were analyzed by a permanent gas analyzer Carle Series 100 AGC while the trace components were analyzed in a GC/MS, Hewlett Packard Model HP 5890A Gas Chromatograph and Model HP 5970 Mass Selective Detector. The major gas components are reported in percent while the trace components were reported as parts per billion by volume (ppbv).

## 2.7 QUALITY ASSURANCE AND QUALITY CONTROL

In order to assure that data gathered during the WDI RI activities are consistent with specific goals of accuracy, precision, completeness and representativeness, the field and laboratory quality control measures applied throughout the program will be discussed in this section as well as identifying nonconformance, field change requests and corrective measures taken to address inadequacies or inconsistencies in the program.

### 2.7.1 QA/QC Objectives for Sample Analyses

The quality assurance and quality control (QA/QC) objectives for soil and groundwater sample analyses performed within the scope of the Contract Laboratory Program (CLP) are defined in the CLP Statement of Work (SOW). The QA/QC for soil and air particulate filter sample analyses performed outside the CLP were defined as Data Quality Objective Level III (EPA March 1987) and according to the guidelines established in EPA SW-846 (November 1986) or 40CFR136 (see Quality Assurance Project Plan for the WDI, Revision 2, July 1988). QA/QC objectives for subsurface gas sample analyses were defined according to the California Air Resources Board (CARB 1987) and ASTM 1945-81 (see Quality Assurance Project Plan for the WDI, Revision 2, July 1988).

Data accuracy and precision for soil and groundwater samples were assessed for each sample lot or lot of twenty samples whichever was the least using: matrix spike, matrix spike duplicate and reagent blank samples. Field, equipment and trip blanks for soil samples were not required by USEPA Region IX. Replicate soil samples were collected at the frequency of 10 percent of all soil samples collected within a week or one per week whichever was the greater. Groundwater sampling equipment and replicate samples were collected at the frequency of one per week or 10 percent of all groundwater samples collected within a week whichever was the greater.

For air particulate filters, one blank filter from each lot of filters was analyzed for metals and semivolatiles contamination. Air filters were



desiccated and weighted in the laboratory prior to use in the field. Filters were backlighted and examined for imperfections prior to weighing and use in the field.

Subsurface gas samples were eventually collected in evacuated canisters instead of Tedlar bag because of permeability of the bags to the migration of methane gas through the bag.

#### 2.7.2 Sample and Document Custody

Samples were identified using an alphanumeric code which identified the project site, sample matrix, sampling location, and depth. The project code for Waste Disposal Inc. was WDI. The matrix identifiers were: SB (subsurface soil), AR (air), GW (groundwater), SG (subsurface gas) and EB (equipment blanks). Sampling locations within each sample matrix began with 01 and increased sequentially. When more than one sample was collected at a location, sequential numbers were used starting with one (01). Equipment blanks were not specifically identified as such in the sample number, but were assigned different sequential numbers which were identified in the sample roadblock and on a Field QA/QC summary form.

All samples were accompanied by a chain-of-custody which were signed and dated noting the time of day by all persons relinquishing and receiving possession of samples until the samples were placed in custody of the analytical laboratory. The chain-of-custody procedures were established to ensure the traceability of the samples from the time of collection to the time the data were used in the final report. Chain-of-custody was broken only once during the RI when a shipment of samples was lost in transport by the shipper while enroute to the analytical laboratory. Duplicate samples which had been archived at the site were sent to the laboratory for analysis instead.

#### 2.7.3 Data Validation, Evaluation and Reduction

Analytical data from CLP laboratories were validated by Ebasco and the USEPA ESAT contractor. The data were validated according to the Functional

Guidelines for Evaluating Organic Analyses (R-582-4-5-01), the Functional Guidelines for Evaluating Inorganic Analyses (November 1985) and the Functional Guidelines for Evaluating Pesticides/PCB's (R582-5-5-01). One hundred percent of the CLP groundwater data were validated. Approximately ten percent of the CLP soil data were validated.

Non-CLP data were validated according to guidelines developed by USEPA Region IX. The air particulate filter data were not validated, and were used for qualitative purposes only.

#### 2.7.4 System and Performance Audits

A field QA/QC audit was conducted on September 13, 1988 at the WDI field site. The purpose of the audit was to identify inconsistencies and potential problems in sample collection, sample preparation and decontamination procedures. The QA/QC audit did not identify any significant problem in the sample integrity or quality.

On October 19 through 21, 1988 an Ebasco Quality Assurance audit was conducted at the WDI site using the applicable portions of the Ebasco Quality Assurance Project Plan for REM III as submitted to and approved by the Environmental Protection Agency. Specific attention was directed to the implementation of the requirements stipulated for the control of site activities by the Field Operations Plan for the site. It was determined that the site activities were being implemented in a satisfactory manner.

On November 15, 1988 an Ebasco Quality Assurance audit was conducted at the Truesdail Analytical Laboratory using the applicable portions of the REM III Guideline LS-3 (Standard Laboratory Operation) and the Ebasco Quality Assurance Project Plan for the REM III Program. It was determined that the Quality Assurance Program implemented at the laboratory was unsatisfactory. Truesdail was requested to schedule full implementation of corrective action which would be reviewed during a follow-up audit. Truesdail was responsible for the analysis of the air particulate filter samples. The corrective action response performed by the laboratory on May 16, 1989 was considered satisfactory.

The USEPA Region 9 ESAT contractor performed an audit of the data validation reports generated by the Ebasco data validation team. Overall, the reports were satisfactory and provided data which was usable to the data user.

Forty four field change requests were generated which addressed deviations from the Field Sampling and Analysis Plan submitted to the Environmental Protection Agency (Table 2-5).

TABLE 2.5

## SUMMARY OF WDI FIELD CHANGE REQUESTS

Field Charge No.	Description	Reason	Date
1.	Use 4" schedule 40 PVC instead of 6" schedule 40 PVC in monitoring wells.	Delay would be incurred to obtain augers needed	9/08/88
2.	Use Monterey #2 sand instead of 99-100% silica sand in monitoring well sand packs.	Significant difficulty in obtaining silica sand. Delays and possible cost overruns not justified.	9/08/88
3.	Use 20 feet of screened internal in monitoring wells instead of 15 feet.	Larger screened internal can cover larger seasonal variations of groundwater levels.	9/08/88
4.	Eliminate collecting equipment blanks for soil instead of collecting them once a week.	The EPA QAM suggested this since the detection limits for soil are so high.	9/14/88
5.	Change decontamination procedure for sampling tubes to eliminate organic-free water rinse.	Organic-free water rinse is unnecessary since equipment blanks for soil are not being collected.	9/09/88
6.	Change decontamination procedure for the split spoon sampler.	New procedure accomplishes the same objective as the procedure in the FSAP.	9/09/88
7.	Collect a minimum of 4 soil samples per boring instead of a minimum of 3 soil samples.	More samples will give a more representative picture of the vertical extent of contamination.	9/12/88
8.	Extend soil borings to at least 35 feet in depth. If contamination or high equipment readings persist, extend boring below contamination or to 5 feet above ground water.	To fully characterize the areal extent of contamination.	9/12/88

TABLE 2.5 (Continued)

## SUMMARY OF WDI FIELD CHANGE REQUESTS

Field Charge No.	Description	Reason	Date
9.	If contamination is present in a boring, a sample will be collected for a non-CLP lab. If at the next sample interval the contamination is still present, the next sample will be sent to the CLP lab.	To conserve budget for non-CLP analyses.	9/13/88
10.	Laboratory quality control samples will not be designated in the field.	Laboratories select on a random basis their own quality control samples.	9/14/88
11.	Replicates will not be collected during the first week of field work.	The start up procedures for field work and the lack of samples collected make replicate sample collection impractical.	9/14/88
12.	Trench pits will be dug with a backhole in areas of geophysical anomalies.	To characterize geophysical anomalies not assessed by the soil boring program due to the spacing of the borings.	9/14/88
13.	Change calibration gas and lamp cleaning procedures for the HNU as stated in H.S.-3.01 of the FSAP.	Toxicity of original calibration gas and fire hazard of original cleaning procedure.	9/15/88
14.	H.S.-3.03 of FASP will not be implemented.	This guideline applies to P.I.D.'s and the OVA's used on-site are P.I.D.'s.	9/15/88
15.	TSP air filters will not be numbered. Instead, the filter envelopes will be numbered.	The lab reports there is no way to number filters without contaminating them.	9/15/89

TABLE 2.5 (Continued)  
SUMMARY OF WDI FIELD CHANGE REQUESTS

Field Charge No.	Description	Reason	Date
16.	Air filters will not be inspected for imperfections in the field, but will be inspected by the lab prior to weighing.	More economical and part of the QA/QC in the lab.	9/13/88
17.	Air filters will not be equilibrated in the field.	Greater ability to affect environmental controls in the lab than in the field.	9/15/88
18.	TSA filters will not be weighed in the field. They will be weighed in the laboratory.	An accurate metlar balance is not present in the field.	9/15/88
19.	High volume air samplers will not be run from midnight to midnight, but will be run for a 24 hour period whenever they can be manually started and stopped.	The timers on the samplers cannot be depended on.	9/15/88
20.	High volume air samplers will not be run for 5 minutes following each sampling period to reestablish run temperature conditions.	This information is recorded daily each time a new filter is installed.	9/15/88
21.	Sample periods for high volume air samples may be greater or less than that stated in the FSAP.	The variability in power sources and access to samplers make it difficult to have a uniform sample period.	9/15/88
22.	The FSAP states that a cartridge will be used with the high volume air samplers. Instad of a cartridge, a gasket will be used.	A different model of high volume air sampler was used.	9/15/88
23.	Change procedure for replacing filters in high volume air samples.	New procedure is consistent with manufacturers specifications.	9/15/88

TABLE 2.5 (Continued)  
SUMMARY OF WDI FIELD CHANGE REQUESTS

Field Charge No.	Description	Reason	Date
24.	Change procedure for checking the meteorological station.	Meteorological station used is of different design than that outlined in the FSAP.	9/16/88
25.	Install a vadose zone monitoring well at SB-090 where a well was not originally planned.	Field observations indicate this location should be monitored.	9/22/88
26.	Install a vadose zone monitoring well at SB-019 instead of SB-011.	Field observations indicate new location should be monitored relative to old location.	10/4/88
27.	Install a product recovery well at SB-068.	As discussed with the EPA, product recovery wells will be installed wherever free product is encountered.	9/23/88
28.	Install a product recovery well at SB-049.	As discussed with the EPA, product recovery wells will be installed wherever free product is encountered.	9/21/88
29.	Install a product recovery well at SB-014.	As discussed with the EPA, product recovery wells will be installed wherever free product is encountered.	9/29/88
30.	Samples from soil cuttings will not be collected and analyzed to determine final disposition of cuttings. Lab results on soil samples collected down-hole will be used.	Change will save approximately \$15,000 in lab costs.	9/28/88
31.	One tedlar bag per lot, not per day of sampling, will be analyzed to determine that the bags are clean prior to use.	Bags in a lot are very similar and this change will save money.	9/22/88

TABLE 2.5 (Continued)  
SUMMARY OF WDI FIELD CHANGE REQUESTS

Field Charge No.	Description	Reason	Date
32.	Missing.		
33.	Missing.		
34.	Missing.		
35.	Change the contingency plan for subsurface gas as outlined in the HASP.	New procedure is safe, practical and improves project productivity.	9/16/88
36.	Discontinue use of aluminum foil to cover ends of sample tubes which will be sent for inorganic analysis.	Analytical laboratories had begun reporting elevated concentrations of aluminum in inorganic samples.	10/3/88
37.	Change procedure for field measurement of Total Petroleum Hydrocarbons (TAH) as outlined in the QAPP.	Old procedure is designed for measuring TPH in water. New procedure is appropriate for soil.	10/3/88
38.	Standard practice is to record one blow count for each 6 inches of sampler. 24 inch sampler was used but only driven 18 inches. Therefore, only 3 blow counts will be recorded on the boring legs.	Only 3 of the 4 6-inch sample tubes in each sampler are being used for sample analysis.	10/3/88
39.	Change from lowering a tube from the HNU to the bottom of the boring after each sample is collected to lowering the tube to the 6-foot depth after a sample is taken.	Original procedure is unnecessary in order to measure the types and concentrations of gas which the HNU is capable of detecting.	10/3/88
40.	Install a ground water monitoring well at SB-016	Field observations indicate this location should be monitored.	



TABLE 2.5 (Continued)  
SUMMARY OF WDI FIELD CHANGE REQUESTS

Field Charge No.	Description	Reason	Date
41.	Convert borings SB-085, SB-086, SB-087 and SB-088 from soil borings to subsurface gas monitoring wells.	High levels of subsurface gas were detected in these borings	10/10/88
42.	Change location of onsite air particulate samplers from 2-4 meters above ground to 1-2 meters above ground.	Air samplers 1-2 meters above ground will provide for worst case conditions and health conservative estimates of risk assessment.	12/1/88
43.	The use of HCL as a preservative for groundwater samples to be analyzed for volatiles will not be practiced.	Use of HCL to preserve water samples to be analyzed for volatiles is an optional practice. this preservative only extends lab holding time and is not desired by EPH labs.	12/1/88
44.	Sample labels and/or sample forms are not to contain the name of the site if sent to CLP laboratories.	CLP laboratories are not to know the origin of WDI samples.	12/1/89

### 3.0 PHYSICAL CHARACTERISTICS OF THE SITE

The description of the physical characteristics of the WDI site are based on analytical data, field observations and information from previous investigations. The specific site features discussed here include surface features, land-use practices, meteorology, geology and hydrogeology. The discussions will focus on describing the location and extent of waste handling areas and estimating the volumes of contaminated soils.

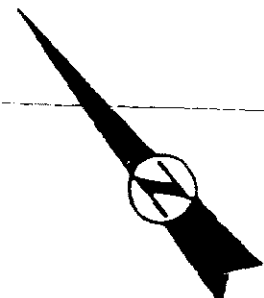
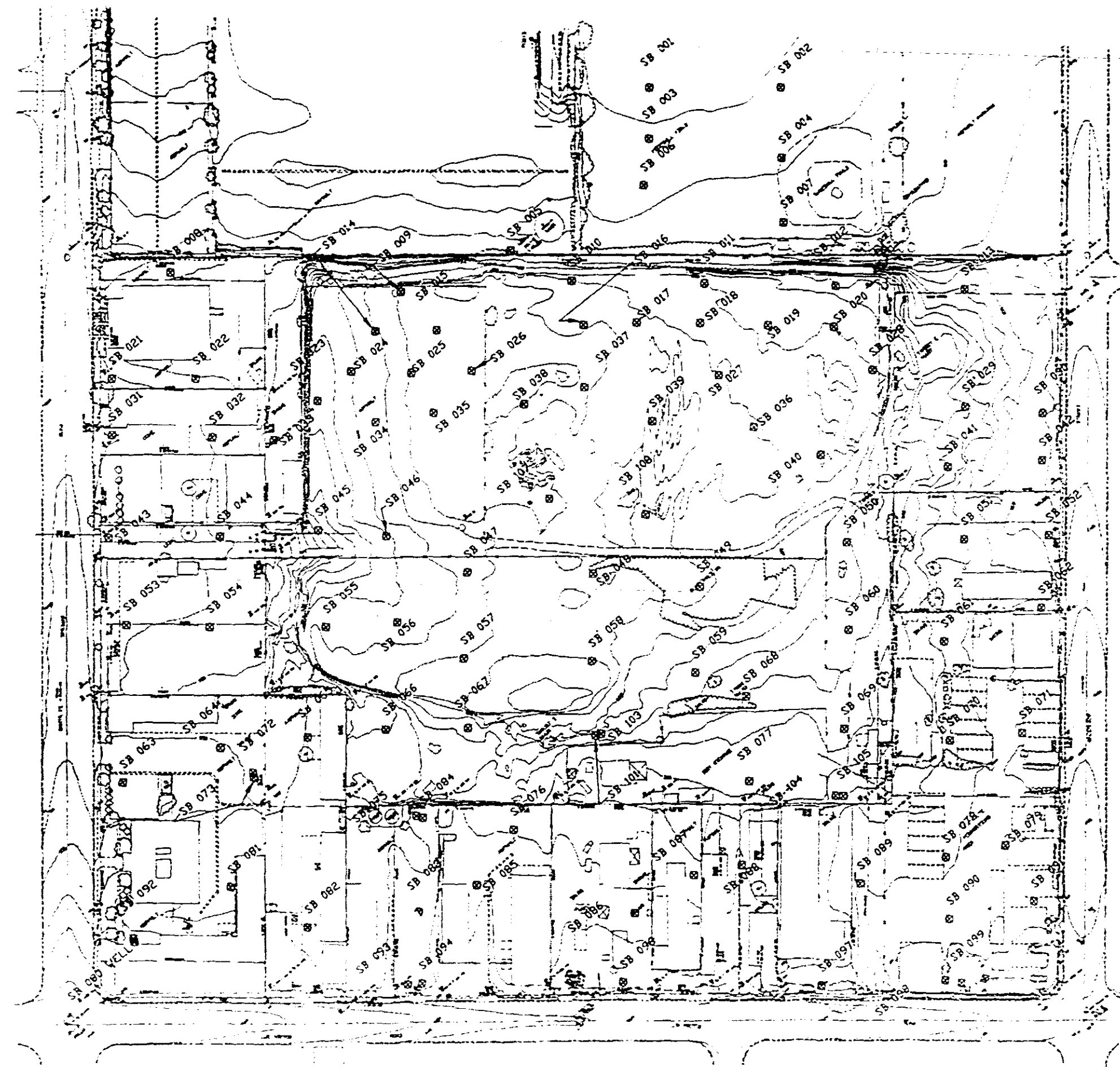
#### 3.1 SURFACE FEATURES

The surface elevation of the Waste Disposal, Inc. site varies from 150 to 168 feet above mean sea level (see Figure 3-1). The central section of the site which overlies the reservoir, has the highest elevation. Steep slopes occur at several places on the site. A 30 to 50 percent slope occurs along the northern border with St. Paul's High School and the Fedco distribution center. A 45 percent slope occurs along the edge of the site between the Santa Fe Springs RV storage lot and Sleet Craft Boats. The drop in elevation to the east and southeast is more gradual (from about a 10 to 30 percent slope).

Surface drainage is complicated due to slope variations and many depressions in the site surface. Water has a tendency to pond in the central section of the site which contains numerous minor ridges and depressions. General drainage for the southern half of the site is to the south and east. The steep northern and eastern slopes drain the areas nearest them.

#### 3.2 DEMOGRAPHY AND LAND USE

Figure 3-2 shows the current land use distribution. Present land use practices on the area occupied by the WDI reservoir are limited. The majority of the reservoir area is covered with fill and a thick growth of vegetation. Other than being used for temporary storage of equipment by local businesses, the reservoir area is currently vacant. Several area residents/workers, however, appear to be using the site to access the surrounding properties.



Approximate Scale

0' 170'

CONTOUR INTERVAL 1 FOOT

### LEGEND

△ HV-1 165.5	HORIZONTAL & VERTICAL CONTROL POINT	☼	POLE LIGHT
○	VERTICAL CONTROL POINT	○ M	METER
165.5	SPOT ELEVATION	□	POLE
—	INDEX CONTOUR	□	BUILDING CANOPY
- - -	INTERMEDIATE CONTOUR	—	BLOCK WALL
—	CURB & CONCRETE OUTTER	—	FENCE
—	ASPHALT ROAD	—	DIRT ROAD
—	TRAIL	—	CONCRETE PAD
□	CATCH BASIN	—	EDGE OF ASPHALT
○ M	MANHOLE	—	RAILROAD
○ P	POST	—	PAINTED LINE
○ T	TRAFFIC LIGHT	—	WATER LINE, DRAINAGE
○ S	SIGN	—	RETAINING WALL
○ W	POWER POLE	—	TREELINE
○ F	FIRE HYDRANT	—	GATE
○ B	BOLLARD	—	OUTTER
○ F	POLE FLAG	—	MANHOLE
○ D	DOLPHIN	—	SOIL BORING
○ V	POS. BARRICADE		
	VALVE		

EBASCO SERVICES, INC.

WASTE DISPOSAL, INC. SITE

Figure 3-1

TOPOGRAPHIC MAP OF  
WASTE DISPOSAL, INC.

In general, the WDI stratigraphy as interpreted across a northwest-southwest trending cross section is as follows:

- o Five to 15 feet of artificial fill material covers the WDI site;
- o Below the fill material is a silt layer ranging from 10 to 25 feet in thickness which is also present across the WDI site; and
- o Below the silt layer is a sandy, pebbly, channelized network of braided river deposits which is at least 50 feet thick.

The detailed cross sections in Figures 3-5 through 3-7 show local stratigraphic variations. These variations can be summarized as follows:

- o Strata beneath the WDI site apparently dip 2 to 4 degrees to the northwest. This is best illustrated by a five-foot thick clay bed overlying a silt layer trending NW-SE which is present on both sides of the WDI site as shown on cross section E-E' (Figure 3-6). The difference in elevation of the clay bed and silt layer on opposite sides of the site as well as the lack of apparent dip on NE-SW trending cross sections suggests that NW-SE trending cross section E-E' is parallel to the direction of dip of WDI strata.
- o A clay and silt layer about 10 feet thick and from 30 to 40 feet below ground level is present under approximately 25 percent of the site. This layer is found predominantly at the southeast end of the site and is interbedded with the sandy, pebbly, braided river deposits. This layer may have been deposited at one time over the entire study area.
- o As suggested by the stratigraphic cross sections, the apparent direction of channeling over most of the site and therefore, the apparent direction of sediment transport is in a NE-SW direction. In a general sense, the NW-SE trending cross sections appear to transect or cut across individual channel profiles, whereas the NE-SW trending cross sections appear to trend parallel to the axis of individual

channels (see cross sections E-E' and F-F' in Figure 3-6). Cross section E-E' apparently transects individual channels and cross section F-F' apparently trends parallel to the axis of various channels. An exception to this apparent NE-SW direction of sediment transport can be found in the eastern corner of the site where the network of channels is more unpredictable (see cross section K-K', Figure 3-7).

#### 3.4.3 Soil Characteristics of Subareas

For the purpose of describing the extent of the contaminated soils, the WDI site is divided into several distinct areas whose physical and chemical characteristics are discussed respectively, in this section and in the next section. The areas selected for detailed discussions include the concrete-lined reservoir which is the primary area of contamination at this site, the waste handling areas adjacent to the WDI reservoir (referred to as Area 1 through 8) and the Fedco/St. Paul High School area immediately upgradient of the reservoir site (Figure 3-8). The waste handling areas are centered around the former location of the containment ponds created to handle wastes as the reservoir reached capacity (Figure 3-9). The physical characteristics of the WDI subareas including the estimated volumes of fill and waste materials have been summarized in Table 3-1. The extent of contaminated areas are estimated based on the visual identification shown on soil boring logs. These values are preliminary estimates and are not ARARs/Risk-based. The FS will provide the final ARARs/Risk-based volumes of contaminated soil at the WDI.

The WDI Reservoir - The WDI reservoir has a circular shape approximately 585 feet in diameter and is located slightly north of the center of the WDI site. Thirteen soil borings were drilled within the perimeter of the reservoir (see Table 3-1 and Figure 3-8). These borings and aerial photos indicate that the sides of the reservoir are not vertical but slope inward. Borings contacted the concrete bottom of the reservoir from 18 to 23 feet below ground level (the difference may be accounted for by sunken debris). Two of the soil borings, SB-057 and SB-059, did not encounter the reservoir's hard concrete bottom, suggesting that at these two locations, the bottom may not

Figure 3-8  
LOCATIONS OF WASTE HANDLING AREAS  
Waste Disposal, Inc.

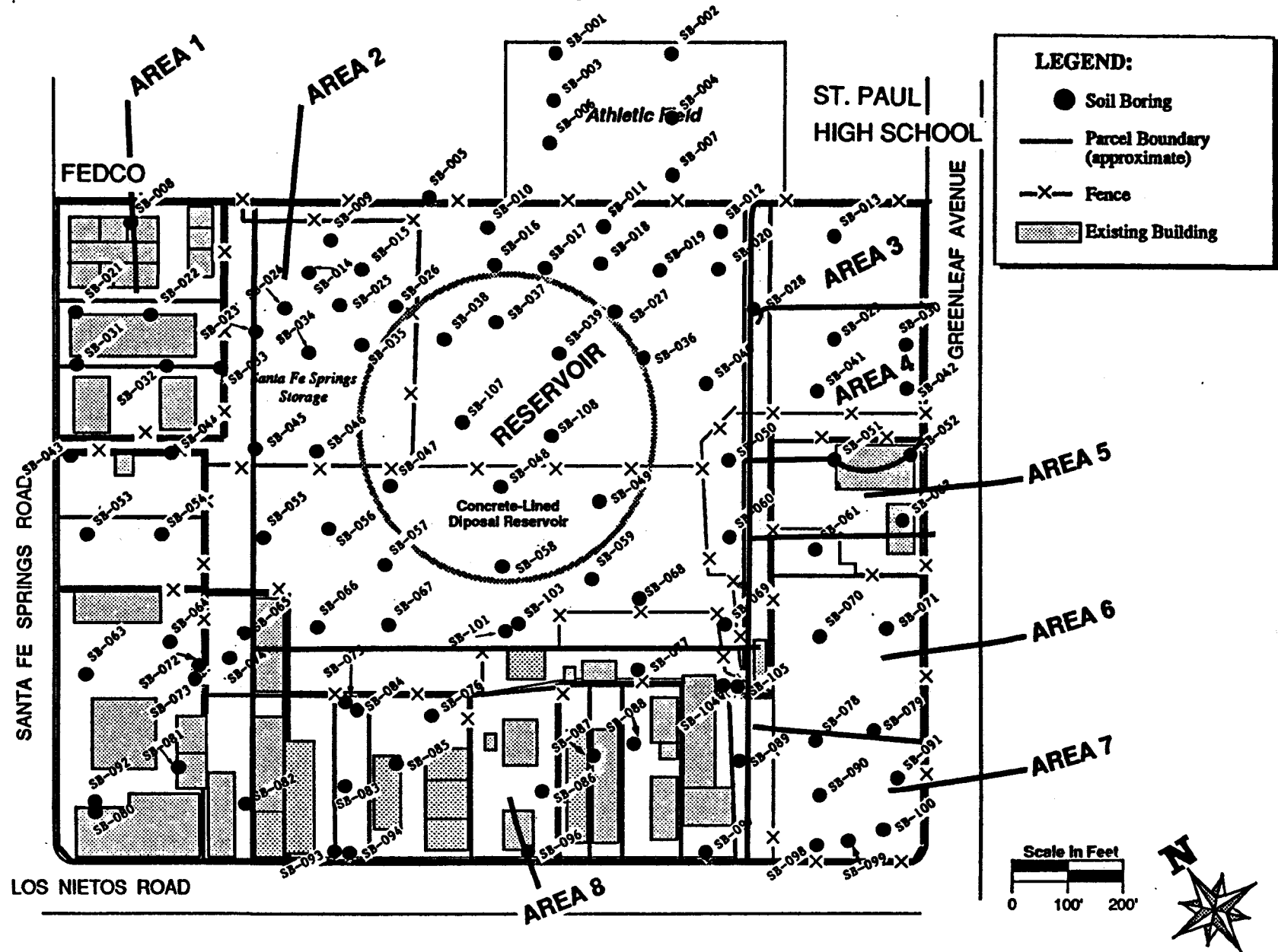
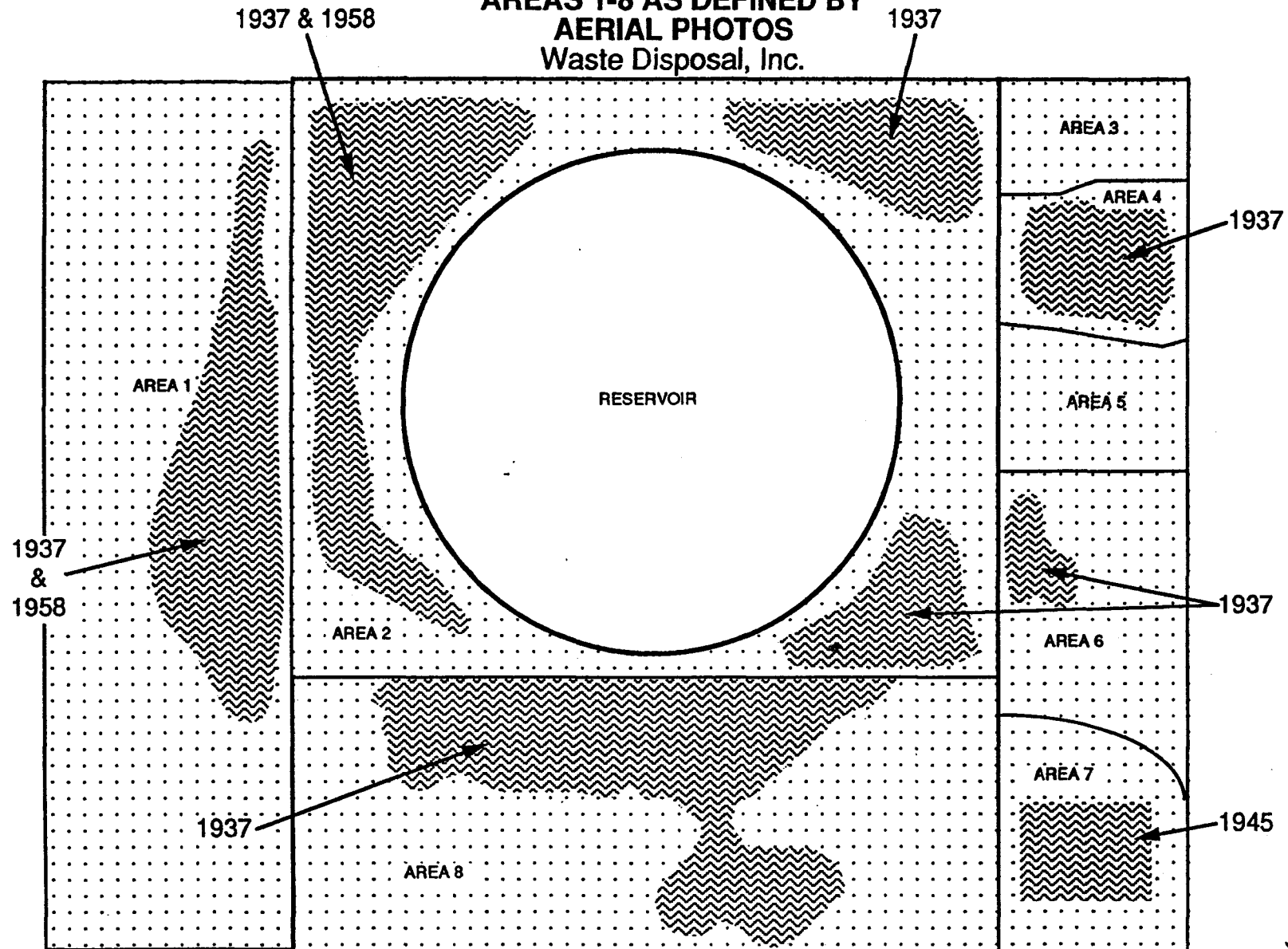


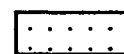
Figure 3-9  
**WASTE HANDLING**  
**AREAS 1-8 AS DEFINED BY**  
**AERIAL PHOTOS**  
 Waste Disposal, Inc.



**LEGEND:** DATES REFER TO YEAR OF  
 AVAILABLE AERIAL PHOTO



Standing Liquid



Extent of Area



Approx. Scale 1" = 200'

TABLE 3-1

## PHYSICAL CHARACTERISTICS OF WDI SUBAREAS

Waste Handling Area	Soil Borings Within Area	Physical Description
Reservoir	SB-026, SB-035, SB-037, SB-038, SB-039, SB-047, SB-048, SB-049, SB-057, SB-058, SB-059, SB-107, SB-108	The WDI Reservoir is circular, approximately 585 feet in diameter. The concrete sides of the reservoir slope inward, and its concrete bottom is from 18 to 23 feet below ground surface. Surface topography is nearly flat, ranging from 5 to 10 feet above the rest of the site. Artificial fill material covering the reservoir ranges from 5 to 15 feet thick. Below the fill material is predominantly "black sludge". Below the base of the reservoir is a few feet of silt underlain by sand. Estimated volumes of waste and fill materials are respectively 174,000 and 58,000 cubic yards.
1	SB-021, SB-022, SB-031, SB-032, SB-033, SB-043, SB-044, SB-053, SB-054, SB-063, SB-064, SB-072, SB-073, SB-080, SB-081, SB-092	Rectangular shape in plan view with dimensions of 300 x 1050 feet. Located along the western border of the site. Topography slopes to the west from 158 to 153 feet above M.S.L. Stratigraphy below area is characterized by sand and silt with interbedded clays. Fill material ranges from 1 to 5 feet thick. Air photos reveal standing liquids were once present. Most contaminants are found at the eastern half of the area between 5 and 20 feet below the surface. Approximately 48,000 cubic yards of waste material and 16,500 cubic yards of fill are present.
2		Consists of area surrounding and immediately adjacent to reservoir. Outer perimeter is 725 x 825 feet, by 10 to 15 feet deep. Elevation varies from 165 to 159 feet above M.S.L. Area has been divided into sections described below. Estimated volumes of waste and fill materials are respectively 150,000 and 54,000 cubic yards.
2	<u>Northwest Corner</u> SB-009, SB-014, SB-015, SB-023, SB-024, SB-025, SB-034, SB-045	<u>Northwest Corner</u> Air photos indicate standing liquids and black sludge, present. Borings reveal contaminated material extends to 25 feet below surface. Sludge, and in some cases free liquids, occur below 10 foot of fill material. The sludge is underlain by a 5 foot thick clay layer.
2	<u>Northeast Corner</u> SB-018, SB-019, SB-020, SB-040	<u>Northeast Corner</u> Air photos show standing liquid was present. Borings reveal 5 to 15 feet of fill material. Below the fill material is contaminated material ranging from 5 to 20 feet below surface. Clay layer is present from 15 to 20 feet below surface.
2	<u>Southwest Corner</u> SB-055, SB-066, SB-067	<u>Southwest Corner</u> Contains black sludge and some free liquid. Fill material ranges from 5 to 10 feet thick and is underlain by 10 to 15 feet of black sludge. North and east sections underlain by a clay bed and south and west sections underlain by sand and silt.
2	<u>Southeast Corner</u> SB-050, SB-060, SB-068, SB-069	<u>Southeast Corner</u> Air photos show standing liquids were present. Fill material ranges from 5 to 10 feet thick and is underlain by 10 to 15 feet of contaminated material. Silt is present below the area to 20 feet below ground surface, which is in turn underlain by sand.



TABLE 3-1  
(Continued)

PHYSICAL CHARACTERISTICS OF WDI SUBAREAS

Waste Handling Area	Soil Borings Within Area	Physical Description
3	SB-013, SB-028	Rectangular shape in plan view with dimensions of 250 x 100 feet. Located at eastern corner of site. Borings located on perimeter of area. Area apparently covered with about 10 feet of fill. Air photos show no standing liquid present. Approximately 9,500 cubic yards of fill material.
4	SB-029, SB-030, SB-041, SB-042,	Roughly rectangular shape in plan view with dimensions of 300 x 220 feet. Located near northwest corner of site. Topography slopes to east from 165 to 154 feet above M.S.L. Fill material ranges from 5 to 10 feet thick. Contaminated material is not found at eastern edge of area. Contaminated material ranges from 5 to 20 feet below surface. Below this area silt and clay grade downward into sand at 25 feet below ground surface. Estimated volumes of waste and fill materials are respectively 34,000 and 9,500 cubic yards.
5	SB-051, SB-052 SB-062	Rectangular shape in plan view with dimensions of 250 x 125 feet. Located in center along eastern boundary of site. Five feet of artificial fill covers the area. No standing liquids were identified in air photos available. The area borings contained no visible contamination. Approximately 5,800 cubic yards of fill material covers the area.
6	SB-061, SB-070, SB-071, SB-079	Roughly rectangular shape in plan view with dimensions of 300 x 320 feet. Located toward southeastern corner of site. Topography relatively flat varying from 156 to 159 feet above M.S.L. Fill material from surface to 5 feet below surface, underlain by waste material to 15 feet. Below area is sand and silt. Air photos reveal some standing liquid was present at one time. Estimated volumes of waste and fill materials are respectively 12,000 and 11,000 cubic yards.
7	SB-078, SB-090, SB-91	Roughly rectangular shape in plan view with dimensions of 300 x 190 feet. Located in southeastern most corner of site. Graded with no significant topography. Area covered with 5 to 10 feet of silty clay and rubble fill, which is underlain by 10 feet of contaminated materials. Drilling mud is predominantly present. Perimeter borings exhibit no visible signs of contamination. A 1945 air photo shows liquid waste present. The contaminated soil is at depths between 10 to 20 feet and has an estimated volume of 3,900 cubic yards. Estimated volumes of waste and fill materials are respectively 3,900 and 5,700 cubic yards.
8	SB-075, SB-076, SB-077, SB-083, SB-084, SB-085, SB-086, SB-087, SB-088 SB-104, SB-105	Rectangular shape in plan view with dimensions of 830 x 300 feet. Occupies southern edge of site. Average elevation range of approximately two feet. Many small businesses cover area. Generally, fill is 5 feet thick underlain by waste material to a depth of 15-20 feet. Waste material is underlain by sand and silt down to 50 feet. Southern half of area appears free of contamination. Air photos suggest north half of area contained standing liquid at one time. Approximately 85,000 cubic yards of waste and 36,000 cubic yard of cover fill.

be intact or as competent as it once was. An areal photo taken in 1945 (see Figure 1-4) also shows how soil was placed immediately around and sloping away from the edge of the WDI reservoir. At present the ground surface above the reservoir is nearly flat and is elevated approximately 5 to 10 feet higher than the rest of the WDI site.

The reservoir appears to be covered with 5 to 15 feet of artificial fill (both soil and debris). The fill is 5 feet thick at the northern edge of the reservoir and thickens to 15 feet at the southern edge. Generally, the fill material lies directly on black mud and sludge that was dumped into the reservoir. In borings, SB-038, SB-047, SB-058, and SB-108, a black viscous material was found. Soil boring SB-059, located at the southern edge of the reservoir, encountered visibly contaminated, black to dark brown, sandy silt as opposed to the more prevalent tar-like material.

The boring, SB-026, encountered silty sand grading to coarse sand within the upper 20 feet with slight hydrocarbon contamination. No visible contamination was found below 25 feet depth. At SB-057, the soil from the first 15 feet in the boring consists of silty clay materials, of which the upper 10 feet contains visible contamination. Below the silty clay at this location to the bottom of the boring (45 feet total depth) is 10 feet of coarse sand. The upper concrete layer of the reservoir was encountered at 10 feet below the ground surface.

The boring, SB-059, also encountered similar conditions to those in SB-026. At this location, the first 5 to 7 feet of soils immediately beneath the ground surface consist of silt. Below this silt layer to the bottom of the boring (45 feet total depth) is 13 to 15 feet of sand. Slight visible contamination was present in this borehole at approximately 15 feet below the ground surface.

As shown on the cross sections in Figure 3-7, correlations between deep bore holes on all sides of the reservoir suggest the base of the reservoir for the most part is placed on 3 to 8 feet of silt which, in turn, is underlain by a widespread sand. The notable exception to this is at the southeast

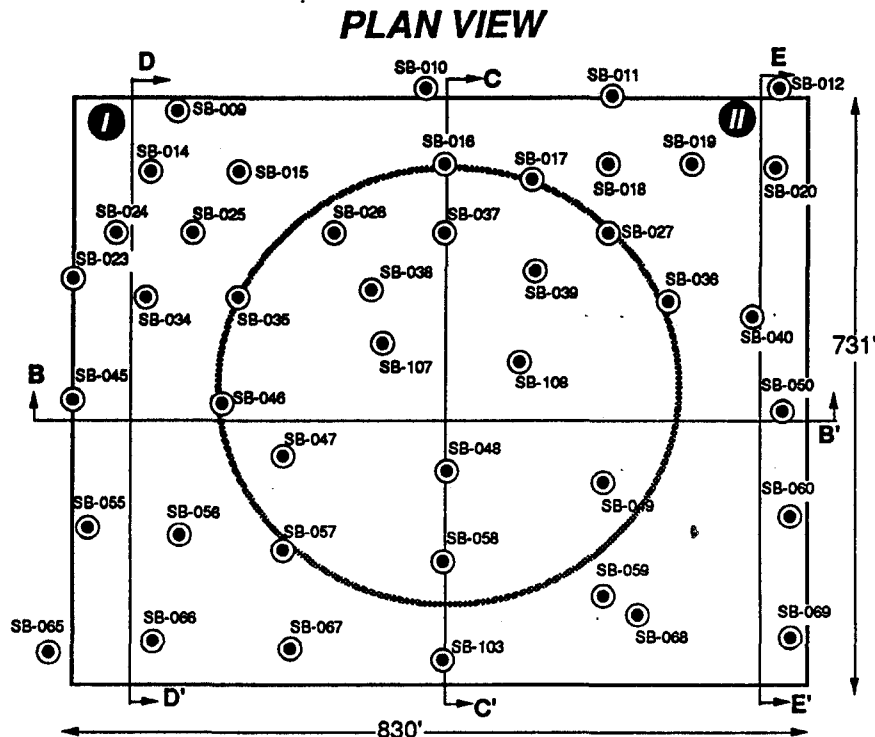
edge of the reservoir where concrete rests directly on sand (see cross section B-B', Figure 3-5).

The WDI reservoir is the main source of contamination in this area and contains a great proportion of the total wastes. Based on the soil boring logs, the average thickness of waste material in the reservoir is about 15 feet which is covered with approximately 5 feet of fill material (Figure 3-10). The estimated volumes of fill and waste materials are respectively 58,000 and 175,000 cubic yards.

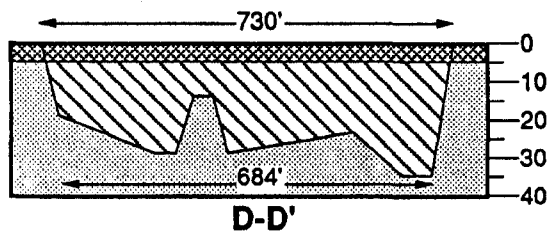
Area 1 - This area is located along the western border of the site (Figure 3-8). This area has a rectangular shape measuring approximately 300 feet by 1050 feet. The eastern edge of Area 1 is located at the base of the steep drop-off between Santa Fe Springs Storage and Slick Craft Boats. The topography of Area 1 slopes to the west, dropping a maximum of 5 feet in elevation, from approximately 158 feet above mean sea level to 153 feet above mean sea level.

Sixteen (16) borings were drilled in this area. Fill material occurs in the borings in the middle of the area (SB-033, SB-044, SB-054, SB-064) and tapers off at the edges, becoming very thin in the border borings (SB-031, SB-032, SB-043, SB-053, SB-080 and SB-081). The stratigraphy of Area 1 is characterized by interbedded clays (see Figure 3-5). Borings SB-021, SB-031, SB-032, SB-043, SB-053, and SB-081 encountered clay layers at approximately 5 feet below ground surface. The clay layer present in SB-081 can be traced through SB-064, SB-072, and SB-073 at a level of 10 feet below ground surface. This clay layer appears in SB-054 at 20 feet below ground surface and seems to disappear entirely in borings SB-044 and SB-033. Overlying this layer near the center of the area, sand and silt can be found between 10 and 20 feet below ground surface, with fill and waste material above this layer to the surface. SB-063 exhibits a clay layer at 20 feet below ground surface, but it may not correlate to the layer appearing in SB-054. Borings SB-080 and SB-092 share a clay layer between 35 and 40 feet below ground surface.

**Figure 3-10**  
**DESCRIPTION OF SUBSURFACE MATERIALS AT AREA 2**  
**AND RESERVOIR**

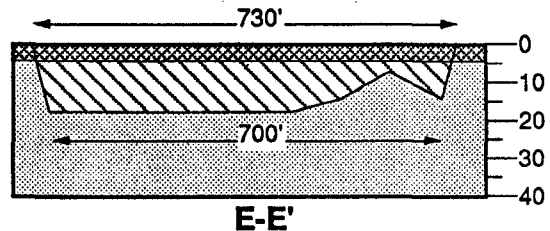


**CROSS-SECTIONAL VIEW OF AREA 2-I**



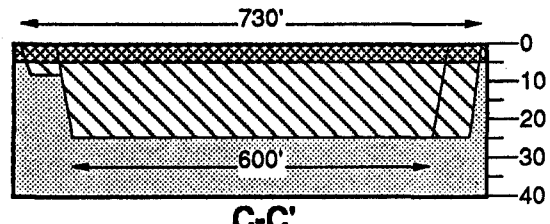
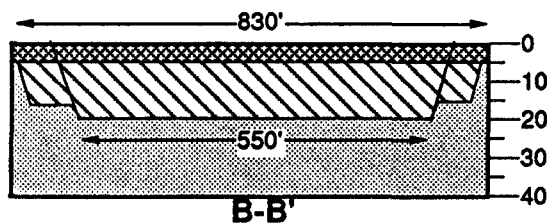
Estimated Volume of Fill Material = 26,283 cubic yards  
 Estimated Volume of Waste Material = 94,836 cubic yards

**CROSS-SECTIONAL VIEW OF AREA 2-II**



Estimated Volume of Fill Material = 27,893 cubic yards  
 Estimated Volume of Waste Material = 55,871 cubic yards

**CROSS-SECTION VIEW OF RESERVOIR**



Estimated Volume of Fill Material = 57,727 cubic yards  
 Estimated Volume of Waste Material = 173,983 cubic yards

**LEGEND:**



A similar clay layer is found in SB-032. In this boring the clay is present from ground surface to 10 feet below ground surface. In borings SB-033 and SB-040, fill and waste material occur from the surface to 10 feet below ground surface. At the 10-foot level, the clay layer is present and at 15 feet below ground surface, silt and clay occur. A similar clay layer is not found in borings SB-044 and SB-054. In the borings where the clay layers are found close to the surface, no waste material is present, as in SB-081, SB-032 and SB-053.

In boring SB-033, black, silty material was found from surface level to 10 feet below ground surface. Native clay is present at 10 feet. Boring SB-044 repeats this sequence, but the waste material here has more clay possibly containing drilling muds. Boring SB-054 contains black sludge at 5 feet and sandy silt with black streaks at 10 feet below ground surface. The silt layer is still present at 15 feet below ground surface and the native clay layer appears 5 feet below that. Boring SB-064 contains fill material within the upper 5-feet and the native clay at 10 feet below ground surface appearing relatively undisturbed. Silt is found at 20 feet below ground surface and grades to sand at the termination of the boring (35 feet total depth).

Soil borings SB-072 and SB-073 yield a brown silty, sandy fill in the upper 5 feet, with waste material present from 5 to 10 feet below ground surface. The brown, native clay appears in SB-073 at 10 feet, but in SB-072 the clay is dark grey and appears to be infused with drilling mud. A sand layer is directly below the grey clay with native clay underlying this sand. Another clay finger appears at the 30 foot level which is underlain with a sand layer. The waste material does not extend south to SB-081. This boring exhibits natural clay layers through the first 20 feet with sand and clay layers alternating below this section.

In the borings in the northern section of Area 1, SB-008, SB-031 and SB-043, no visible contamination was noted. Similarly, in the southern section, borings SB-063, SB-080 and SB-092 show no signs of visible contamination. Soil borings indicate that soil contamination is present in this area in two separate locations where the past presence of standing liquid wastes has

been identified by aerial photos (Figures 1-3 and 1-5). The approximate extent of contamination at these locations is shown in Figure 3-11. As determined from the boring information, the upper 5-feet of soil is covered by fill material and asphalt. The contaminated soil is at depths ranging from 10 to 25 feet. The estimated volumes of waste and fill materials are respectively 48,000 and 16,500 cubic yards.

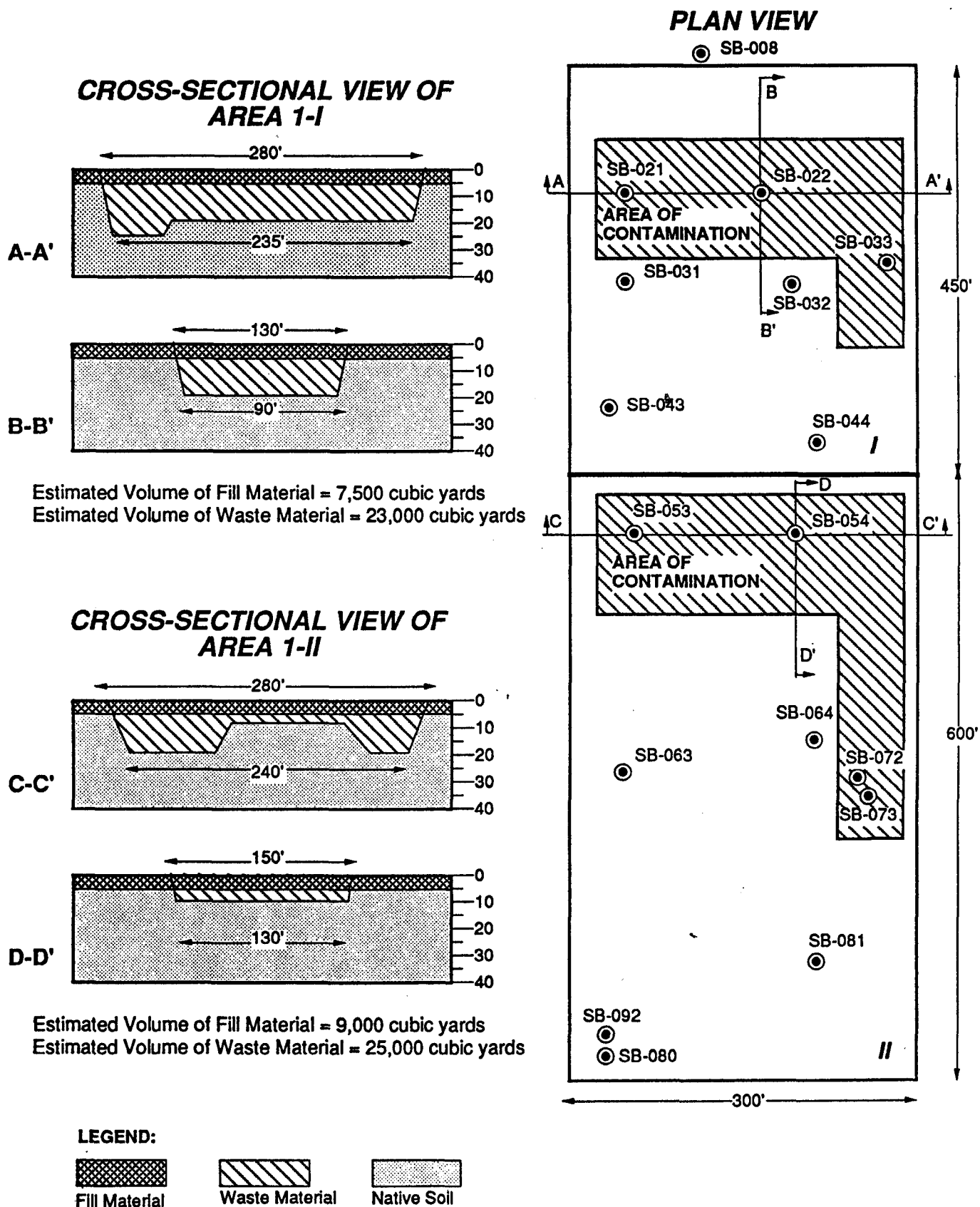
Area 2 - This area consists of land surrounding and immediately adjacent to the reservoir (Figure 3-8). The outer perimeter of this area measures 725 feet x 825 feet. The ground surface of this area varies in elevation from 159 to 165 feet above mean sea level.

Twenty-two (22) borings are located inside the area boundaries and seven (7) borings are located between the interior of Area 2 and the outer edge of the reservoir. According to the boring logs, most sections of Area 2 are covered with fill material. The thickness of the fill on the eastern side of the waste handling area varies from 0 to 10 feet. In the northeast corner, the thickness of fill material varies from 10 to 15 feet. Along the south border, the thickness of fill varies from 5 to 10 feet.

Aerial photos show the northwest and northeast corners of Area 2 as distinct units (Figure 1-5). This is consistent with the material encountered by borings in these areas. This material is different from other areas within Area 2 but is homogeneous with respect to its location. Aerial photos indicate standing liquids, black sludge and dark liquids in the northwest corner (Figure 1-3). The borings in this area confirm that a large pocket of waste material of this type extends to a maximum depth of 20-25 feet. Sludge and, in some cases, free liquids occur between 7 to 10 feet, just under the fill material. In most borings, sludge and free liquids are underlain by a 5-foot clay layer. In boring SB-034, however, this clay layer is absent. The waste material in this area appears to extend to 25 feet below ground surface.

Aerial photos also show dark standing liquid in the northeast corner of Area 2 (see Figure 1-3). The borings in this area contain 5 to 15 feet of brown to tan sandy silt with large amounts of rubble (fragments of concrete

**Figure 3-11**  
**DESCRIPTION OF SUBSURFACE MATERIALS AT AREA-1**



and brick) underlain by waste material from 5 to 20 feet below ground surface. At a depth between 15 to 20 feet, a brown clay layer is found.

Borings SB-010, SB-011 and SB-012 are located along the northern border of Area 2, between the main reservoir area and the edge of the steep dropoff near St. Paul's High School. Waste material in SB-010 occurs from 1 to 16 feet below ground surface. This area may have been impacted by some lateral seepage of waste materials around the northern crown of the reservoir but the extent of contamination does not appear to be extensive. SB-011 and SB-012 show no signs of the waste material and therefore, the northern extent of the material was placed at approximately 20 feet south of these borings based on the aerial photos.

Both of the southern corners of Area 2 contain sludges and liquids. In the southwest corner, fill varies in thickness from 5 to 10 feet. It is underlain by 10 to 20 feet of black sludge. This sludge is underlain by a clay layer at 20 feet in SB-055 and SB-067. In SB-066, no clay layer occurs and the waste material extends to 25 feet below ground surface. Boring SB-065, on the eastern edge, contains no waste material and is probably outside the waste handling area.

The borings, SB-068 and SB-069, in the southeast corner of Area 2 confirm the presence of liquid waste seen in aerial photos (see Figure 1-3). The fill layer in these borings is 5 to 10 feet thick. The fill is underlain by 10-15 feet of waste material. Boring SB-050 showed slight traces of contamination at 10 feet below ground surface but no indication of waste material. Boring SB-060 is south of SB-050 and shows no sign of visible contamination. A dark brown silt is found to twenty feet below ground surface underlain by sand down to the boring terminus.

Seven borings are located in the transition area between the reservoir and Area 2 (Figure 3-8 and Table 3-1). The reservoir and Area 2 were apparently separated by an earthen berm as indicated by these borings. SB-016 is the only boring which contains visibly contaminated material. This material occurs between 5 and 7 feet below ground surface. SB-046, SB-101 and SB-103 contain minor amounts of contamination which may have migrated from a



neighboring waste handling area. Borings SB-056, SB-027 and SB-036 show no signs of waste material and appear to be entirely inside the berm (outside the area). The clay layers beneath all portions of Area 2 are underlain by fine to coarse grained sand.

Area 3 - This area is located at the eastern corner of the WDI site (Figure 3-8). This area is rectangular in shape with dimensions of 250 feet by 100 feet. No soil borings were drilled in Area 3 since based on aerial photographs, liquid waste was not disposed of in this area. Soil boring SB-013 is located along the northern border of the area while SB-028 is located at its southern border.

Based on boring logs from surrounding boreholes, Area 3 appears to have been covered with approximately 10 feet of fill material. The estimated volume of fill material is 9,500 cubic yards. Below the fill layer is about 10 feet of silt which is underlain by at least 15 feet of sand. From the cross sections (Figures 3-5 through 3-7), there may be about 5 feet of silt between the bottom of this area and loose sand.

Area 4 - This area has a rectangular shape approximately 300 feet by 220 feet. The surface slopes to the east, toward Greenleaf Avenue, with elevation dropping from 165 feet to 154 feet above mean sea level. Four borings, SB-029, SB-030, SB-041 and SB-042, are located within the area and borings, SB-028 and SB-051 are in the area vicinity. Boring logs indicate that a brown, silty, sandy fill is present from the surface to a depth of 5 feet at SB-041 and to a depth of 10 feet at SB-029. Blocks of orange tile and other concrete rubble are present throughout this fill layer. A soft, dark gray to black waste material occurs directly below this fill layer and extends to about 20 feet below the surface. This material is generally moist, relatively soft and sticky. The organic vapor analyzer indicated high readings inside borings drilled in this area. Below 21 feet, sandy silt occurs in SB-029 and SB-041 and below 25 feet a gray silty clay layer is present which grades to fine sand and coarse sand below.

On the north border of Area 4 is boring SB-028. Fill material occurs to a depth of 5 feet below ground surface. The fill material is underlain by 5

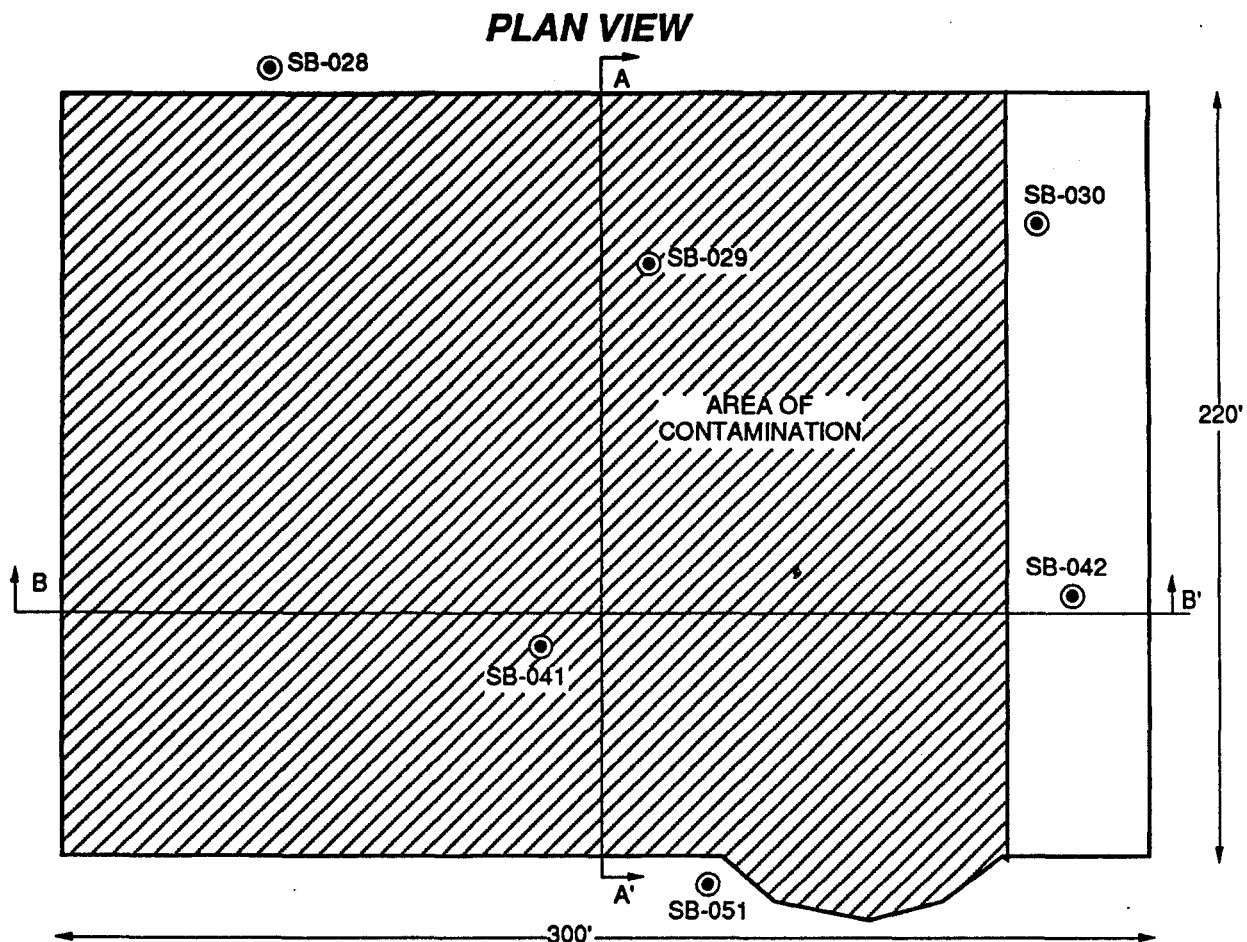
to 10 feet of stiff, black silt and clay mixture layer. The fill material also occurs at SB-051 to 5 feet below ground surface but no contaminated layer appears in this boring. Silt, clay and sand grade to sand at 25 feet below ground surface with no visible contamination. In the eastern area, along Greenleaf Avenue, borings SB-030 and SB-042 contained fill material from 0 to 7 feet below ground surface. No waste material occurs in either boring. Silt and clay grade downward to sand only. The sand layer starts at 25 feet below ground surface.

Aerial photos show dark standing liquids in this area (Figure 1-3, 1-4 and 1-5). The area covered by liquid waste has an approximate rectangular shape with estimated dimensions of 260 feet by 220 feet. The contaminated area is assumed to overlap the former location of the waste pond. A narrow 20-foot strip near Greenleaf Avenue is relatively free of contamination. Figure 3-12 shows the dimensions of the contaminated areas. The estimated volumes of the fill and waste materials are respectively 9,500 and 34,000 cubic yards.

Area 5 - This area is located along the southeastern edge of the WDI site (Figure 3-8). This area is rectangular in shape with dimensions of 250 feet by 125 feet. No standing liquids were shown in this area by aerial photos (Figures 1-3 and 1-4). Three soil borings, SB-051, SB-052 and SB-062, were drilled in this area. According to the boring logs, the area is underlain by 5 feet of fill material. Below the 5 feet depth, silty clay and clay materials are present to the depth of 20 feet, underlain by sand to the borings termination depth of 35 feet for SB-051 and SB-052 and 60 feet for SB-062. Soil samples from this area did not show any visible contamination. The estimated volume of fill material covering the area is 5,800 cubic yards.

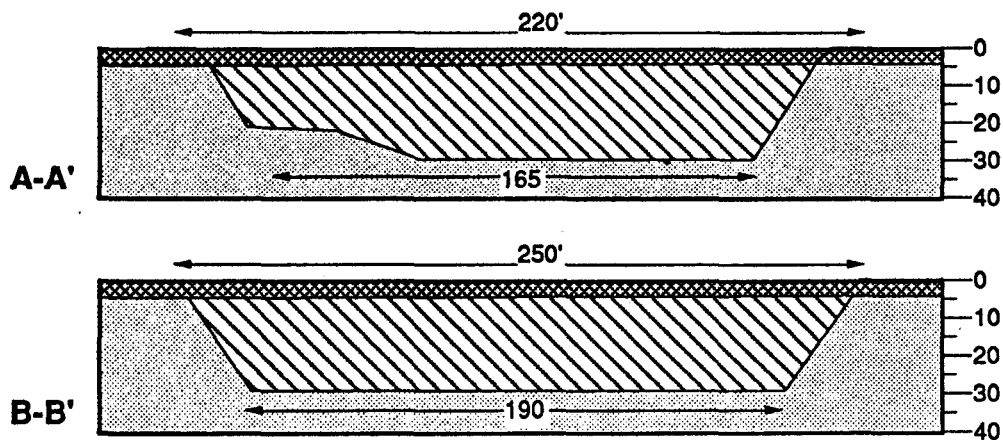
Area 6 - This area is found toward the southeastern corner of the site (Figure 3-8). This area is rectangular in shape approximately 300 feet by 320 feet with the long axis trending north to south onto the Campbell property. The surface is relatively flat and its elevation varies from 159 feet to 156 feet above mean sea level.

Figure 3-12  
DESCRIPTION OF SUBSURFACE MATERIALS AT AREA-4



**CROSS-SECTIONAL VIEW**

**LEGEND:**



Estimated Volume of Fill Material = 9,500 cubic yards  
Estimated Volume of Waste Material = 34,000 cubic yards

Four (4) soil borings, SB-061, SB-070, SB-071 and SB-079, are located within the area boundaries while SB-078 lies on the southern border of the contamination area. The boring logs indicate that the upper 5-feet of soil consists of dark brown silt and sand fill material. A dark brown to gray clay with some silt is found from 5 to 20 feet below ground surface. This section seems relatively free of visible contamination. A native sand layer underlies the clay layer appearing between 20 feet and 35 feet below ground surface. Another clay layer occurs below the sand layer down to the deepest extent of the soil borings, 35 feet below ground surface.

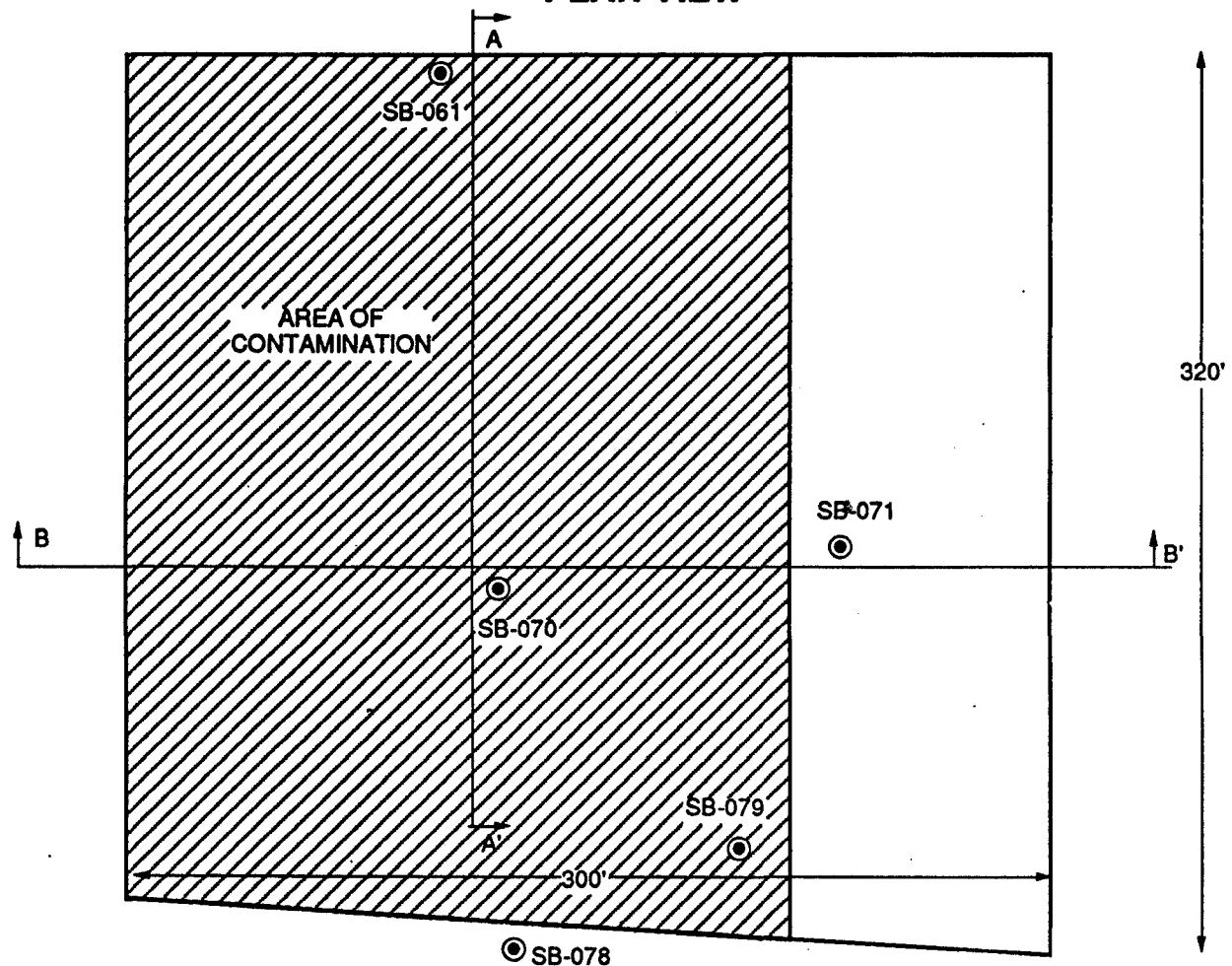
Boring SB-071 also has a mixture of sand and clay which is dominated by sand. The clayey material may have been washed off in this area by a stream channel and replaced with sand. Except for the upper section of fill material, SB-071 seems to be relatively natural undisturbed soil. The border borings, SB-078 and SB-079, along the southern edge of the area, share many of the same physical characteristics as the borings within the waste handling area. These borings include layers of fill, clay and sand corresponding to those in SB-061 and SB-070.

An aerial photo taken in 1937 shows standing liquids over approximately two-thirds of Area 6. The area underlying the former location of the liquid wastes has an approximately rectangular shape with dimensions of 300 feet by 320 feet (Figure 3-13). This contaminated area is centered around SB-070, which has shown some visible contamination at a depth of 5 to 10 feet. Soil contamination was also observed at SB-061 at a depth of 5 to 15 feet. Using information from boring logs and the aerial photo, the extent and volume of the contaminated soil was estimated (see Figure 3-13). Accordingly, the waste material has an estimated volume of 11,000 cubic yards and the cover fill material has an estimated volume of 12,000 cubic yards.

Area 7 - This area is located in the southernmost corner of the WDI site near the intersection of Los Nietos Road and Greenleaf Street (Figure 3-8). The Campbell property is presently within this area's boundaries. This area is roughly rectangular in shape with dimensions of approximately 300 feet by 190 feet. Presently, the area is graded and contains no significant slope.

Figure 3-13  
DESCRIPTION OF SUBSURFACE MATERIALS AT AREA-6

**PLAN VIEW**



**CROSS-SECTIONAL VIEW**

**LEGEND:**



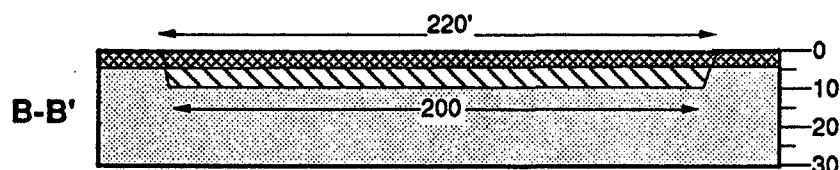
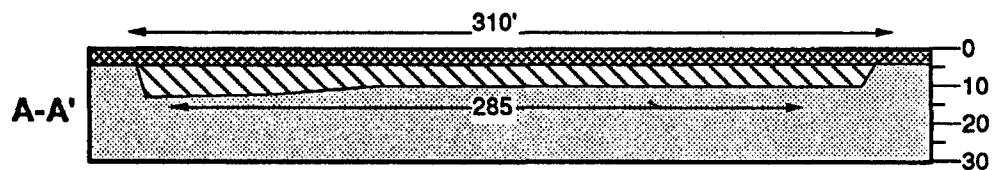
Fill Material



Waste Material



Native Soil



Estimated Volume of Fill Material = 11,000 cubic yards

Estimated Volume of Waste Material = 12,000 cubic yards

Seven (7) soil borings SB-078, SB-089, SB-090, SB-091, SB-098, SB-099, and SB-100 are located in this area. According to the boring log for SB-090, the contamination area is covered by approximately 5 feet of fill material consisting of silty clay and rubble. The fill layer is underlain by 5 to 10 feet of partially contaminated fill and wet, visibly contaminated, black to dark gray waste material. Dark gray, wet, drilling mud is present in this boring from 10 feet to 20 feet below ground level. Below 20 feet, the boring log describes a native, fine to medium grained sand with no visible contamination.

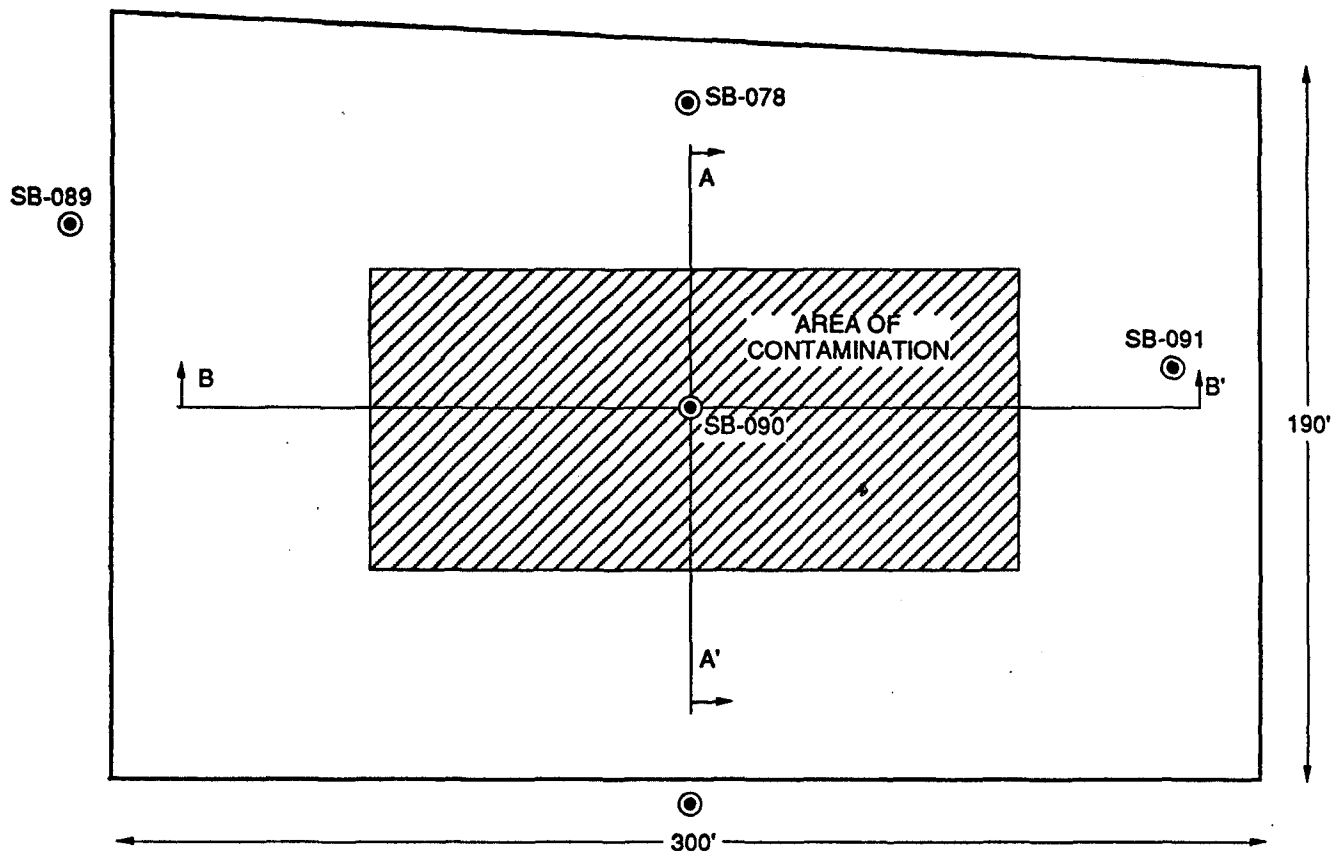
The samples from soil borings SB-078, SB-089, SB-091, SB-098, SB-099 and SB-100 have no visible contamination. These borings indicate that the upper 5 feet below ground level consists of fill material. From 5 feet down to 10-20 feet below ground level is a native silty, clayey layer. Fine to medium grained sand is present below this silty layer.

An aerial photo taken in 1945 indicates that a waste handling pond containing liquid wastes was present in this area (Figure 1-4). The waste area has a rectangular shape with dimensions of approximately 180 feet by 100 feet. Based on the 1945 aerial photo and boring logs, the waste handling area appears to have been centered around SB-090 (Figure 3-14). The waste materials are contained between depths 10 to 20 feet. The upper 10-foot soil is mainly fill material but it is partially contaminated below 5-feet. The estimated volumes of fill and waste materials are, respectively, 5,700 and 3,900 cubic yards.

Area 8 - This area occupies the southeast edge of the site along Los Nietos Road (Figure 3-8). This area has a rectangular shape approximately 825 feet by 300 feet. The area is relatively flat with average elevation changing approximately two feet across the area. Some excavation and grading has occurred in preparation for the small business development. Aerial photos suggest that an even distribution of standing liquids was present in this area at some time. Many small businesses are within the area boundary including Stansell Brothers, Colorplus Graphics, A and H Auto Body, Reyes Containers, Terry Trucking, I.C.E., Bolero Plastics, Timmons Wood Products, Dan Ray, California Reamer, Davco, World Wide Plastics, H. H. Contractors

Figure 3-14  
DESCRIPTION OF SUBSURFACE MATERIALS AT AREA-7

**PLAN VIEW**



**CROSS-SECTIONAL VIEW**

**LEGEND:**



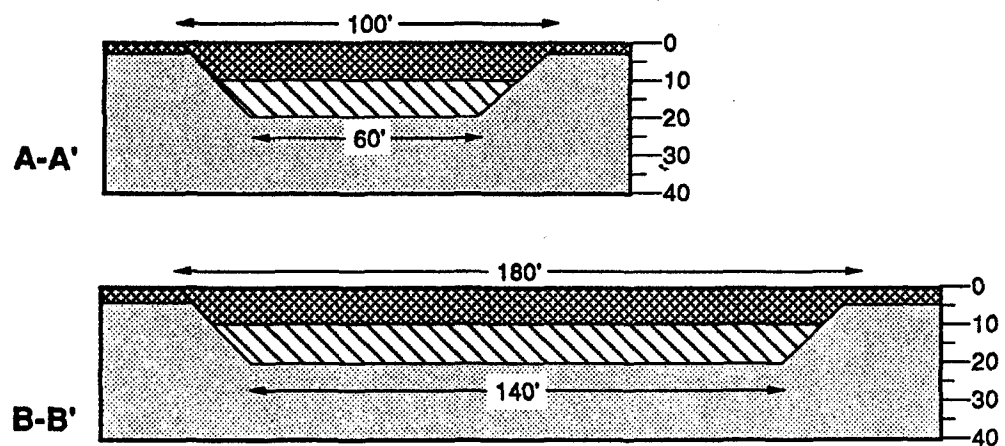
Fill Material



Waste Material



Native Soil



Estimated Volume of Fill Material = 5,700 cubic yards  
Estimated Volume of Waste Material = 3,900 cubic yards

and Rick's Smog Service. The property formerly owned and operated by Toxo Spray Dust is also included in this area.

Eleven (11) soil borings are located within the boundaries (Table 3-1 and Figure 3-8). A brown, silty fill material is found from the surface to 5 feet below ground surface in the majority of borings. Fill material is underlain by waste material (dark gray silty material and black sludge) at depths between 7 to 15 feet. This material has the consistency of mud and is moist or wet. Below the waste material, a sand and silt layer is present to a depth of 20 to 50 feet which is underlain by clay. Three borings, SB-076, SB-087 and SB-093, seem to be exceptions to this stratigraphic trend. Below the top 5 feet of fill material, each of these borings encountered 10 to 15 feet of native clays. These clays are underlain by sand to the depth of 35 feet. These borings appeared to be free of visible contamination.

The borings near the perimeter, SB-082, SB-093 and SB-094, have no waste materials present and they show no visible contamination. The upper 20 feet of soil in these borings consists of clay and silt with clay and sand dominating at 20 feet below ground surface. Boring SB-096 indicates a 5-foot layer of fill near the surface. This layer is underlain by sand of varying grain size. SB-097 also exhibits fill from the surface to 5 feet underlain by layers of interbedded sand and clay down to 65 feet below ground surface.

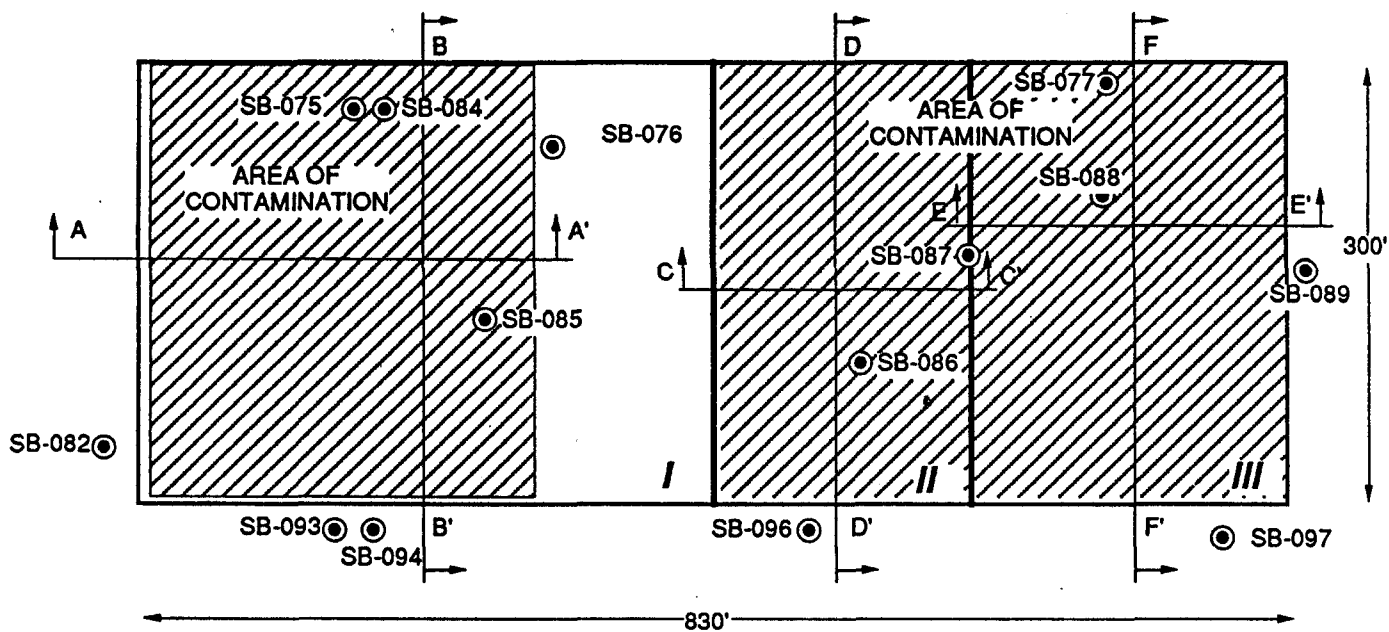
Area 8 is divided into three subareas to facilitate estimating the contaminated-soil volumes (Figure 3-15). The borings logs were studied closely to help define the extent of the contaminated zone. The boundaries and depths of the contaminated areas have also been shown in Figure 3-15. Except for an area approximately 135 x 300 feet near the middle of Area 8, the remaining areas appear to be moderately contaminated at depths ranging from 15 to 20 feet. The estimated volumes of the waste material and the fill that covers the area are respectively 85,000 and 36,000 cubic yards.

Areas Upgradient of WDI Reservoir - St. Paul's High School and Fedco Distribution Center are located upgradient of the Waste Disposal, Inc. site (Figure 3-8). Six borings were completed on the school's athletic field,



Figure 3-15  
DESCRIPTION OF SUBSURFACE MATERIALS AT AREA-8

**PLAN VIEW**



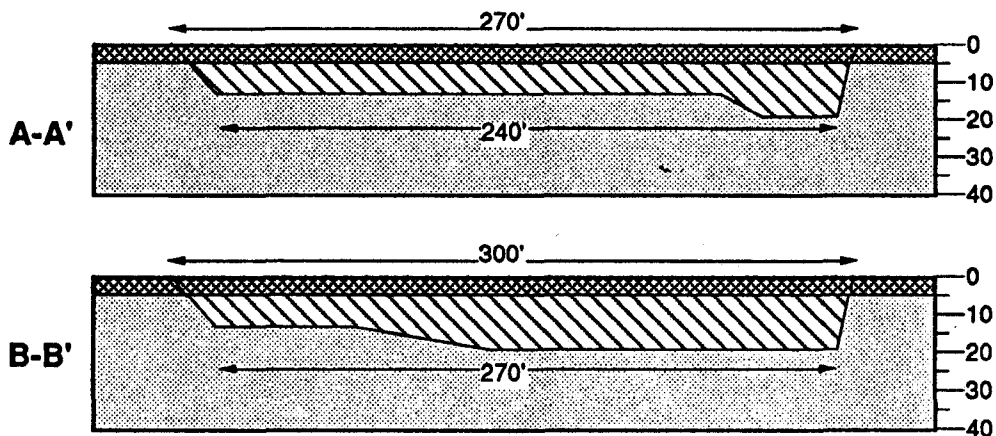
**CROSS-SECTIONAL VIEW OF AREA 8-I**

**LEGEND:**

 Fill Material

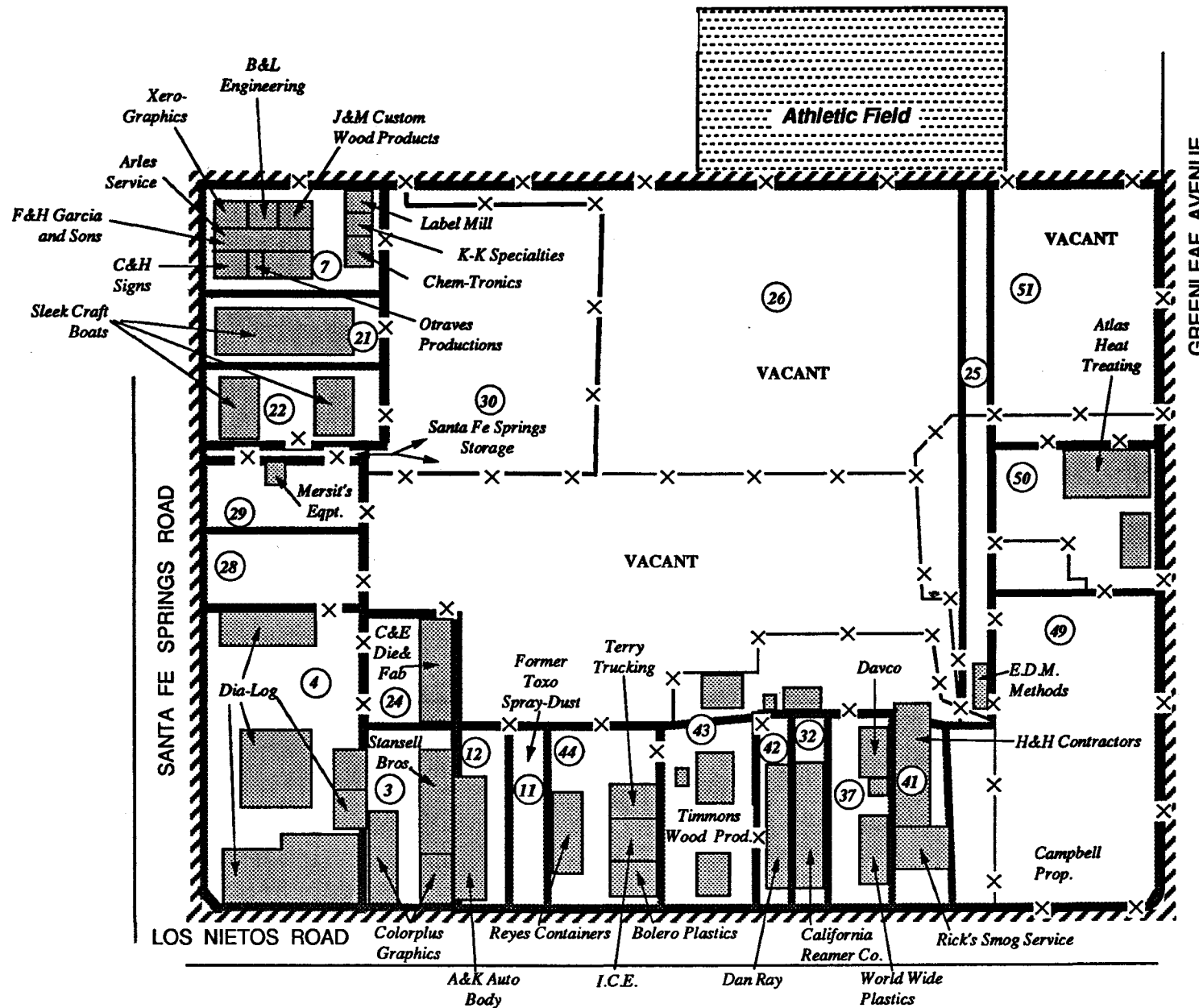
 Waste Material

 Native Soil



Estimated Volume of Fill Material = 14,500 cubic yards  
Estimated Volume of Waste Material = 28,000 cubic yards

Figure 3-2  
**LAND USE MAP**  
 Waste Disposal, Inc.



**LEGEND:**

- Existing Buildings
- Parcel Number
- Parcel Boundary (approximate)
- Site Boundary
- Fence

**Parcel Owners:**

- 3 - Raymond Holbrook
- 4 - Dia-Log Company
- 7 - Ralph Horowitz
- 11 - Ovil Proctor
- 12 - Ovil Proctor
- 21 - John Maple, Lucille Ferris
- 22 - John Maple, Lucille Ferris
- 24 - Raymond Halbrook
- 25 - Joe Bennett
- 26 - Joe Bennett
- 28 - James Mersits
- 29 - James Mersits
- 30 - Joe Bennett
- 32 - David Neptune
- 37 - George Ortega
- 41 - Gene Welter
- 42 - Meade Peoples
- 43 - Ed Timmons
- 44 - Gale Searing
- 49 - Phil Campbell
- 50 - William Elliot
- 51 - Joe Bennett

Scale in Feet  
 0 100' 200'



To the north and west is the Fedco food distribution center, which includes a large warehouse with numerous loading docks, railroad tracks, a water tank and a storage yard. To the west is a large building which is shared by at least eight tenants including Sleek Craft Boats, F & H Garcia Plumbing, Xerographics, B&L Engineering, J&M Custom Wood Products, Label Mill, and K-K Chemtronics. Northwest of the reservoir is the Mersit's Equipment Sales and Service building. Located between Sleek Craft Boats and Mersit's is Santa Fe Springs Storage which includes only a narrow access road from Santa Fe Springs Road, a trailer/office, and an asphalt-covered lot used for the storage of recreational vehicles (RVs).

To the west of Santa Fe Springs Storage and the WDI reservoir is Dia-Log, an oil well logging company. Also to the west are a number of small businesses. These businesses are located immediately to the north and east of Los Nietos Road. They include Color Graphics Plus, A&K Auto Body, Whittier Wood Products, Dan Ray, California Reamer Company, Rick's Smog Service and Auto Repair, and a sawmill. As recently as 1986, Toxo Spray Dust, Inc., a pesticide manufacturing and storage facility, was also located in this area.

To the south of the WDI reservoir is a parcel owned by Mr. Phil Campbell. A large portion of this property at the corner of Los Nietos Road and Greenleaf Avenue is now vacant. However, a group of quonset huts were located here until late 1987. These quonset huts were used by numerous businesses which at various times included but were not limited to a machine shop, an ornamental nursery and an explosive manufacturing and storage facility. At present, the lot is vacant with the exception of four (4) quonset huts which remain along the east side of the property adjacent to Greenleaf Avenue. The southern two quonset huts are owned by Mr. Campbell and are used for general storage purposes. Atlas Steel Treating, a metals finishing business, owns the northern two quonset huts and the lot on which they reside.

To the southeast and east of the site across Greenleaf Avenue are residences. To the northeast is St. Paul's High School whose athletic fields and parking lot immediately border the site. Behind St. Paul's is a large office complex which is currently being partially used by Primo Warehouse Distributors.

### 3.3 METEOROLOGY

The meteorological conditions in the site vicinity during the RI activities were determined from data collected from an on-site 10-meter station. Based on hourly averages of the data, the average daily temperature was about 70°F with a maximum of 106°F during the 66-day measurement period (8/30/88 to 11/3/88). The average wind speed was approximately 4.8 miles per hour (mph) out of the south-southwest (a bearing of about 195 degrees), while the maximum wind speed recorded was 14 mph. During the daytime hours when the RI activities occurred, the wind direction was generally more from the west than the south-southwest. No measurable precipitation was recorded during this period.

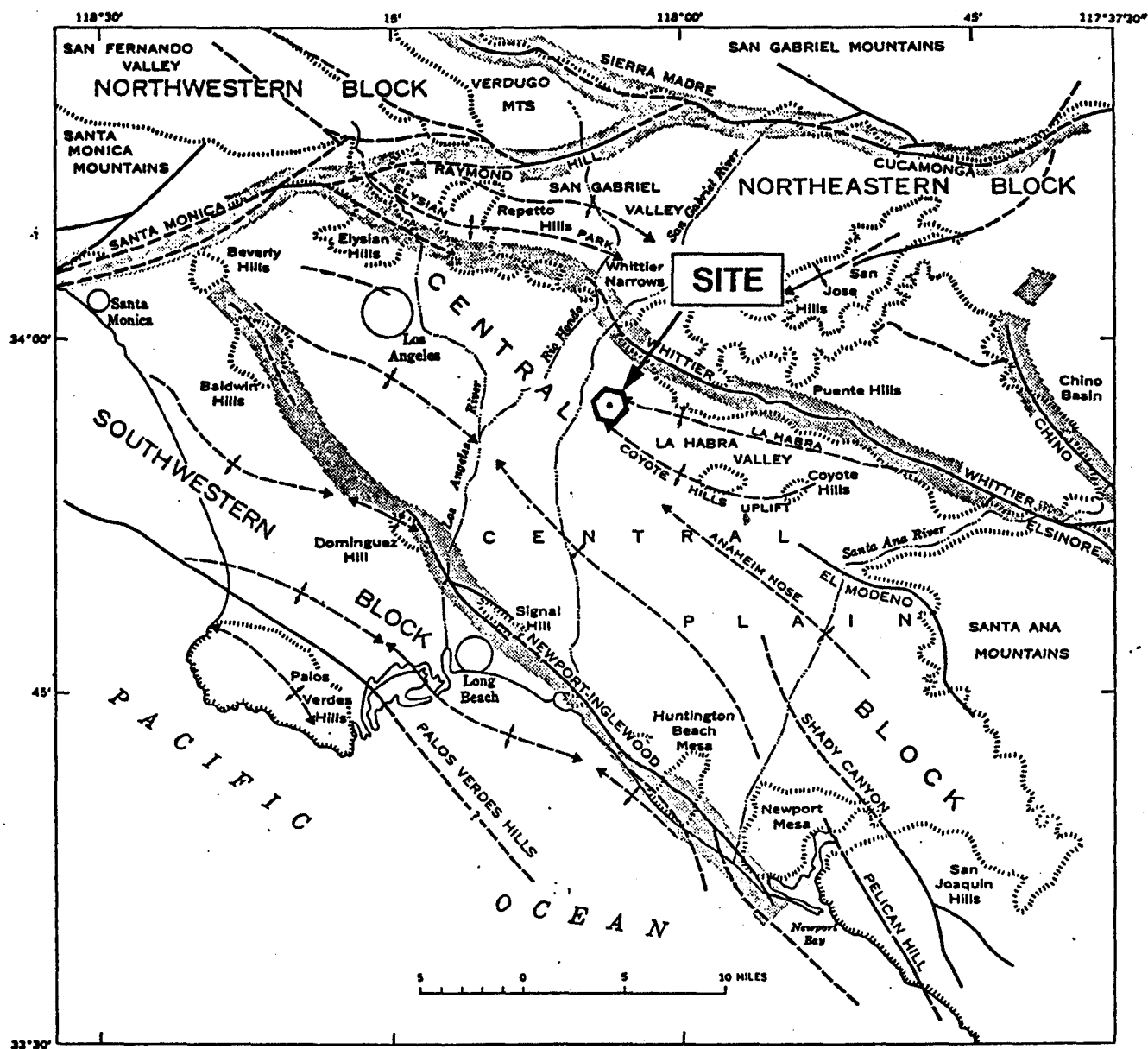
### 3.4 GEOLOGY AND SOILS

Regional geology, site-specific geology and the detailed characteristics of the WDI subareas are discussed in this section. The regional geology is described based on the California Department of Water Resources documents (DWR, 1961). The description of the site-specific geology was based on lithologic information obtained during the WDI RI activities. Subsequently, the WDI site was divided into separate subareas where the soil characteristics were studied closely to estimate boundaries of the waste disposal areas.

#### 3.4.1 Regional Geology

The WDI site is located northwest of the Santa Ana Mountains, a dominant part of the northern Peninsular Ranges of coastal southern California which forms the eastern margin of the Los Angeles basin (Figure 3-3).

Situated in the central block of the Los Angeles Basin, the WDI site is bounded on the northeast by the La Habra syncline and on the southwest by the Coyote Hills (Santa Fe Springs) anticline in an area commonly referred to as the Santa Fe Springs Plain. This plain is a gently rolling topographic feature which has probably been warped by the Santa Fe Springs - Coyote Hills anticlinal system and dips gently both to the northeast toward Whittier and



#### EXPLANATION

WHITTIER  
Fault or fault zone  
Dashed where approximately located;  
guaranteed where doubtful

Anticline  
Dashed where approximately located

Syncline  
Dashed where approximately located

Boundary of structural block

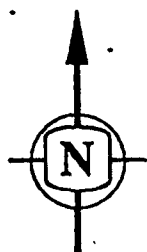


Figure 3-3  
**LOS ANGELES BASIN  
PHYSIOGRAPHIC AND MAJOR  
STRUCTURAL FEATURES**

SOURCE: Adapted from Yerkes, R.F., et. al. (1965).

to the southeast toward the Downey Plain. The difference in elevation ranges from 100 to 175 feet above sea level (DWR 1961). The surface of the Santa Fe Springs Plain and the Coyote Hills reflects a structural high which trends northwest from the Coyote Hills in Orange County and is primarily developed in underlying formations of Miocene and Pliocene age. In these sediments, the uplift consists of anticlinal folds which contain the Santa Fe Springs, Leffingwell, and West Coyote oil fields. The San Pedro and Lakewood formations are similarly folded across the uplift, and the folds developed in these sediments generally correspond to the underlying structures.

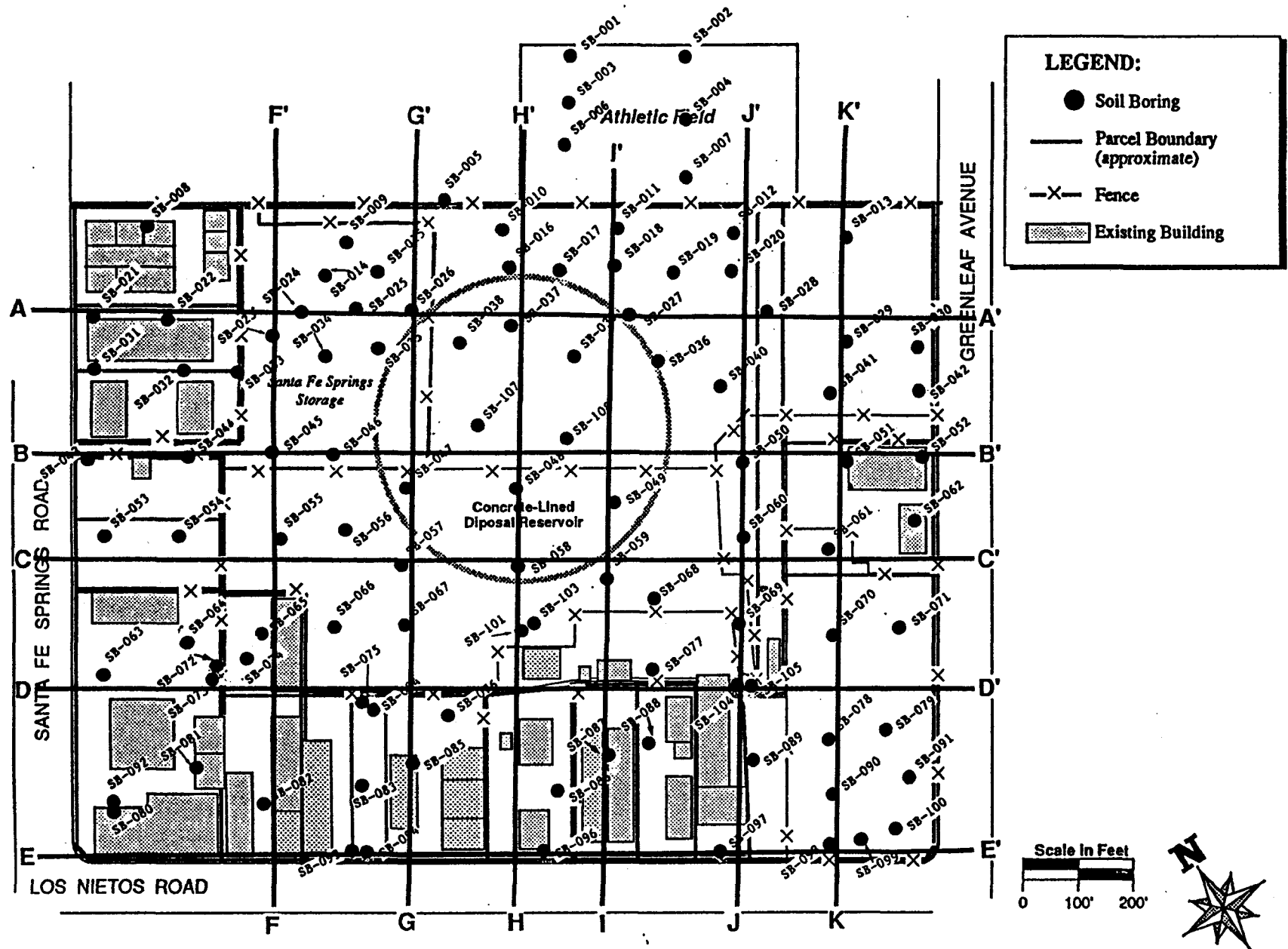
The Lakewood formation is exposed on-site at the surface and includes what has previously been termed "terrace deposits," "Palos Verdes sand," and "unnamed upper Pleistocene deposits." Maximum thickness of this formation has been measured to be about 340 feet at Lakewood, California (DWR 1961). Materials range in size from cobbles to clay, with fine deposits separating the lenticular sandy and gravelly beds.

#### 3.4.2 Site-Specific Geology

The site-specific geologic characteristics of WDI were examined by constructing several stratigraphic cross sections of the site. Each cross section consists of five to twelve soil boring logs placed side by side. In all, eleven cross sections were constructed to show the stratigraphic relationships based on the site's boring logs (Figures 3-4, 3-5, 3-6, and 3-7). Five of the cross sections trend NW-SE and the remaining six cross sections trend NE-SW forming an approximate 200 feet x 200 feet grid across the site.

The WDI soil boring logs and cross sections indicate that WDI strata consist of fluvial deposits. The soils are coarse grained, occasionally pebbly, channelized sands surrounded in places by finer grained, lower energy, and laterally extensive beds. This suggests a braided river system depositional environment. The variable thickness (3 feet to 20 feet) and variable lateral extent (30 feet to 1500+ feet) of individual channel deposits below the site is a result of the continuous active fluvial channel-cutting/depositing events.

Figure 3-4  
LOCATION OF  
STRATIGRAPHIC CROSS SECTIONS



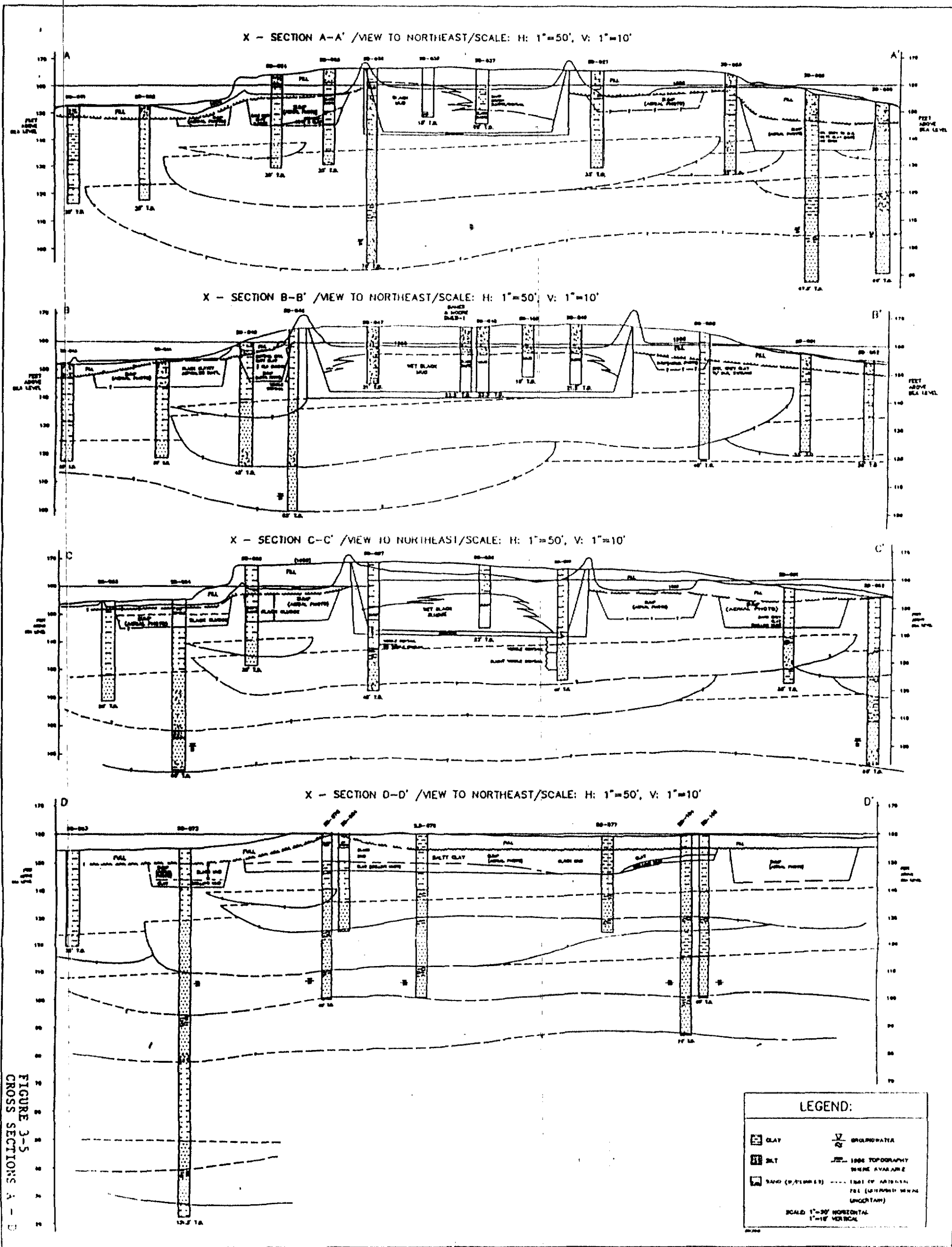
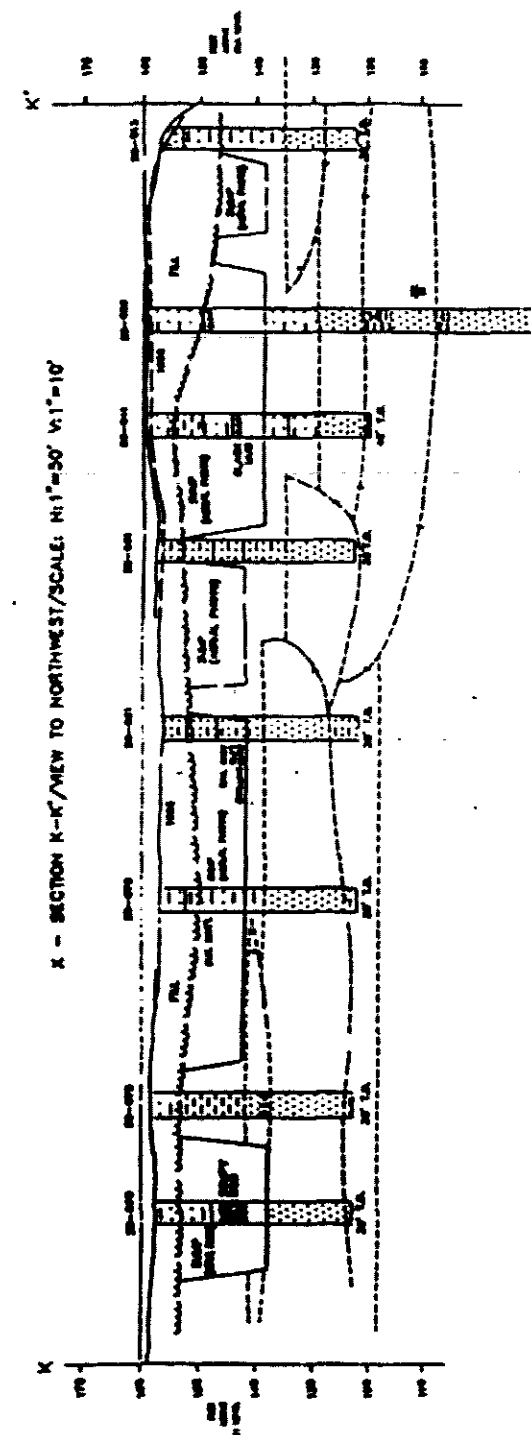
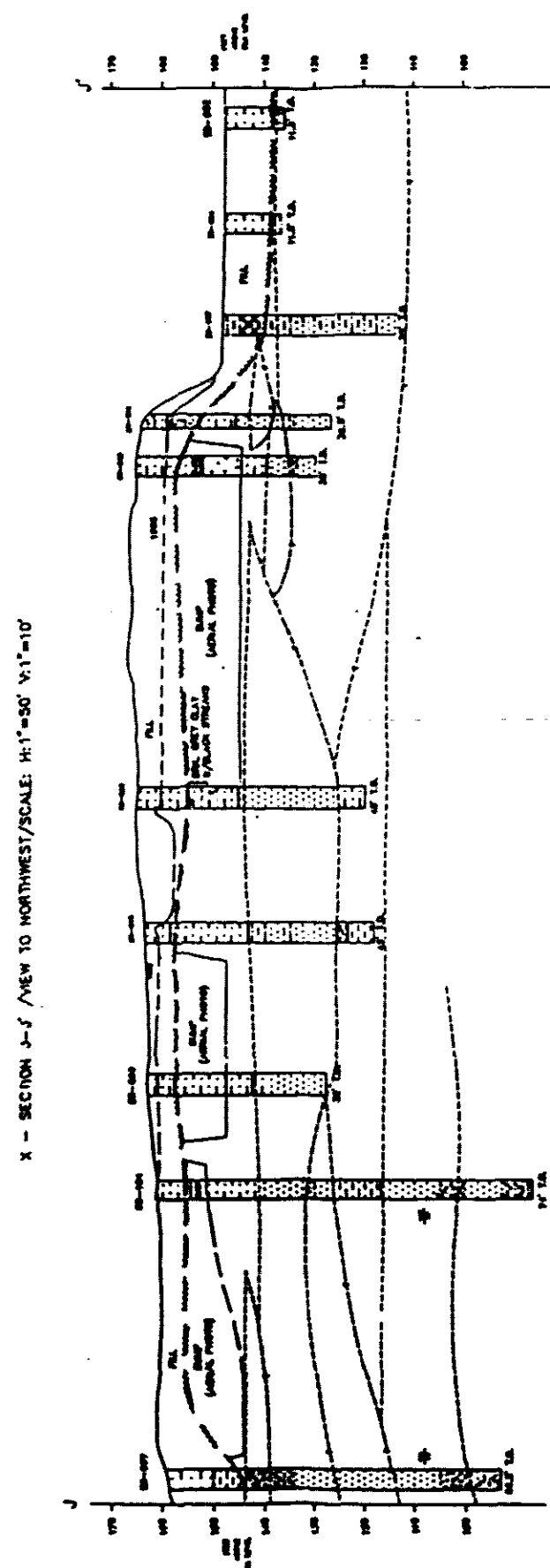
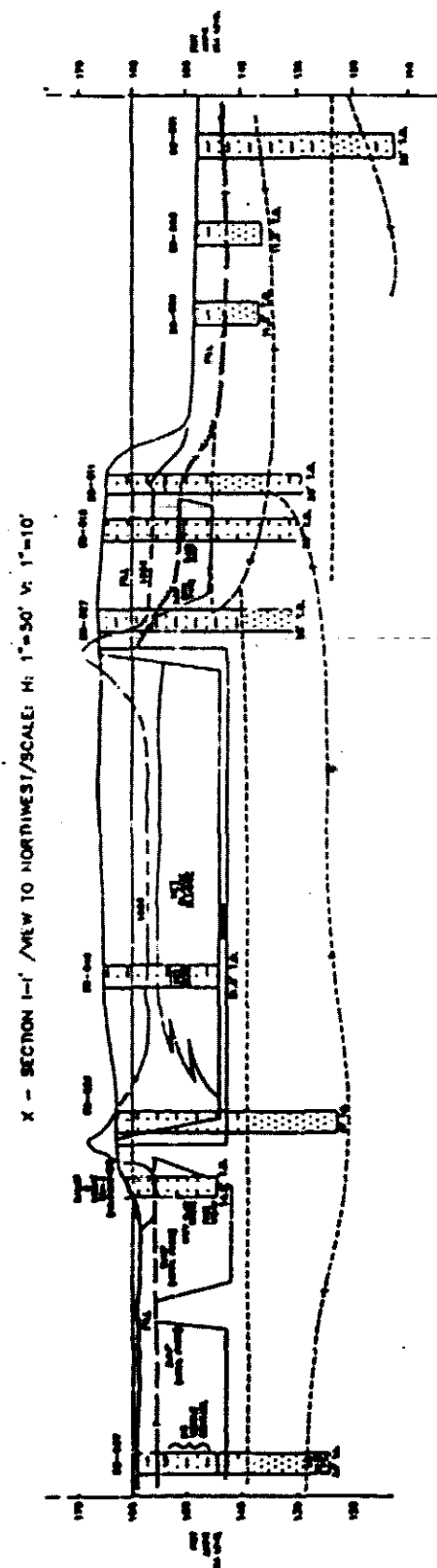


FIGURE 3-5  
CROSS SECTIONS A - D



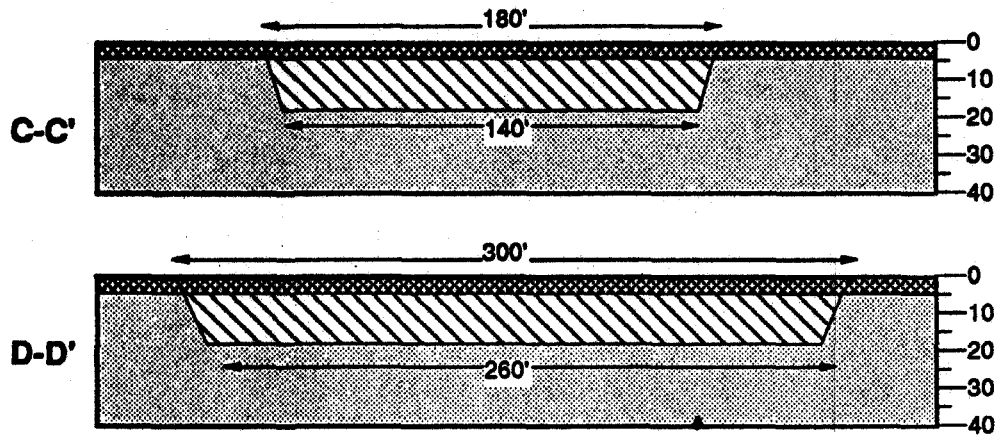




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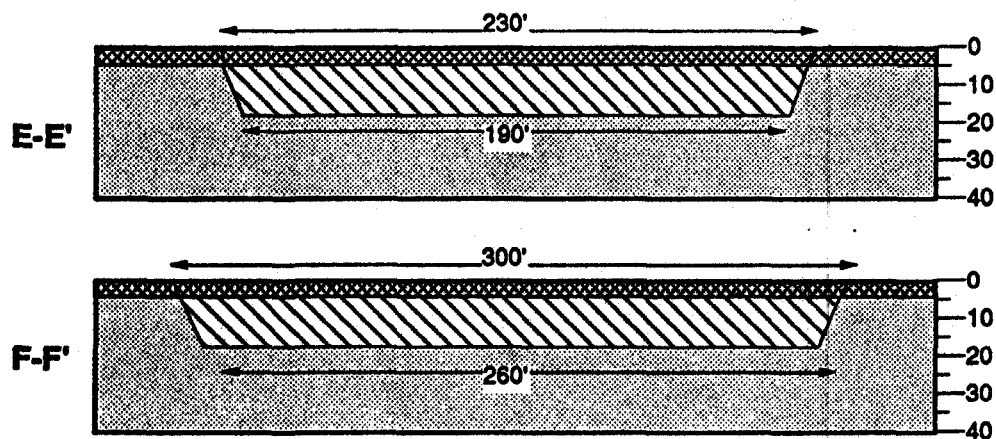
FIGURE 3-7  
CROSS SECTIONS I - K

Figure 3-15 (continued)  
**CROSS-SECTIONAL VIEW OF AREA 8-II**






Estimated Volume of Fill Material = 9,500 cubic yards  
 Estimated Volume of Waste Material = 25,000 cubic yards

**CROSS-SECTIONAL VIEW OF AREA 8-III**



**LEGEND:**

-  Fill Material
-  Waste Material
-  Native Soil

Estimated Volume of Fill Material = 12,000 cubic yards  
 Estimated Volume of Waste Material = 32,000 cubic yards

SB-001, SB-002, SB-003, SB-004, SB-006, and SB-007. The area occupied by the athletic field was originally farmland. No waste dumping can be inferred from aerial photos although in 1962, a spill from the WDI reservoir may have resulted in overland runoff from the site coming in contact with the St. Paul's High School athletic field. SB-005 lies outside the school boundary on Fedco property that was also originally farmland. In general, layers of silt, clay and sand beneath St. Paul's High School and Fedco appear to be undisturbed (see boring logs in Appendix C).

### 3.5 HYDROGEOLOGY

This section describes the hydrogeology and groundwater flow conditions at the WDI site. A summary of regional hydrogeology and groundwater use in the WDI area as defined extensively in the California Department of Water Resources (DWR) documents is provided below. The site specific data obtained from the WDI groundwater investigation was used to define the flow directions and groundwater condition within the WDI site.

#### 3.5.1 Regional Hydrogeology

The WDI site is situated in the Whittier Area of the Central Groundwater Basin (DWR 1961). The Whittier Area is overlain by the La Habra Piedmont Slope and part of the Santa Fe Springs Plain and the Coyote Hills. The known water-bearing sediments, extending to a depth of about 1,000 feet (800 feet below sea level), include Recent alluvium and the Lakewood and San Pedro Formations (Figure 3-16). A part of the underlying Pliocene and older deposits may also contain water of good quality. Electric logs of oil wells indicate fresh water at a greater depth than has been penetrated by water wells.

Recent alluvium in the Whittier Area consists of a thin layer of sand, gravel, and clay, which extends into the western portion of the area from the Montebello Forebay Area. The sediments are 80 feet thick near the western boundary of the area, and thin out to the east. The Recent alluvium contains a portion of the Bellflower aquiclude.

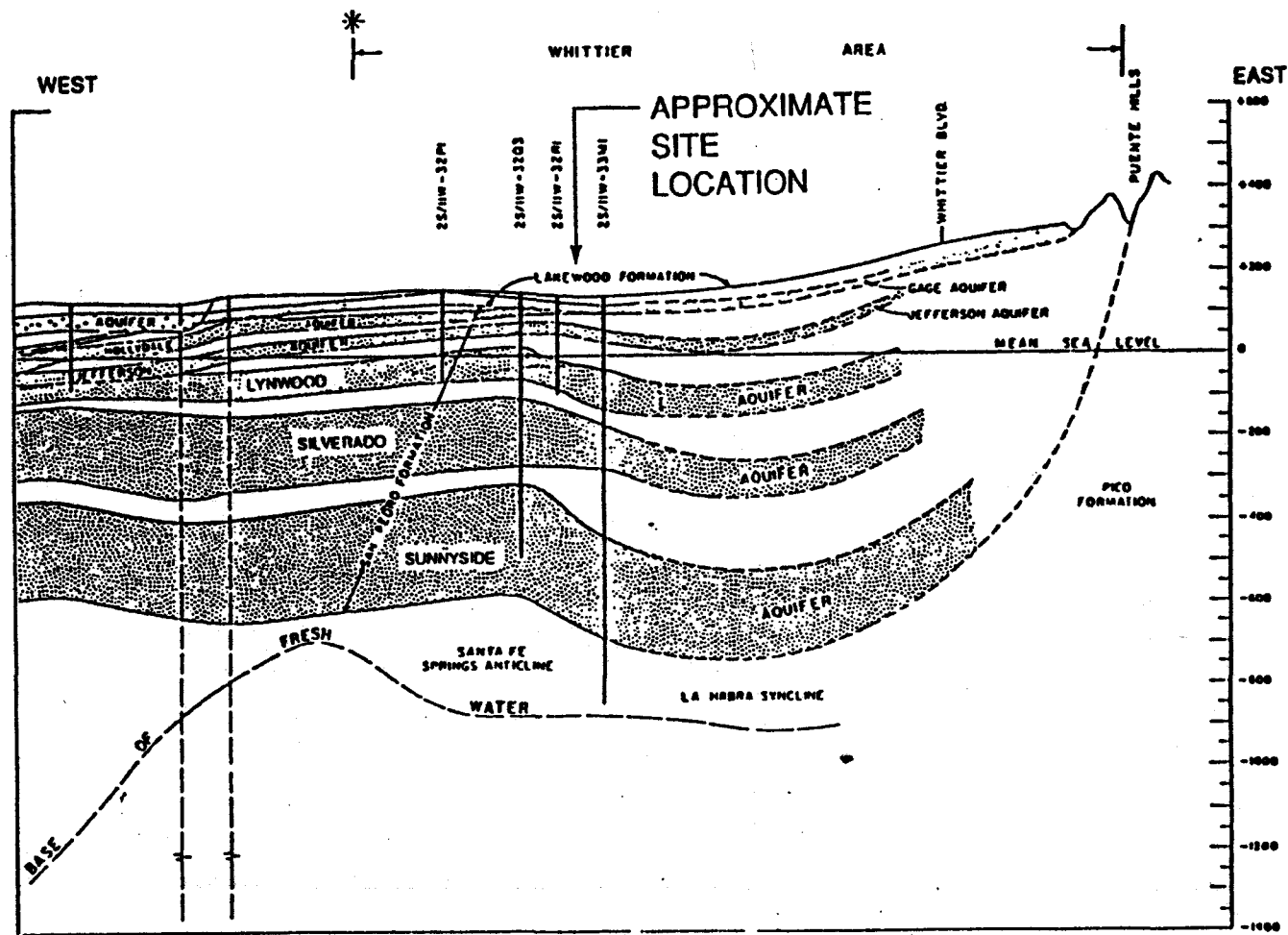


Figure 3-16  
WHITTIER AREA  
CROSS SECTION OF  
WATER BEARING STRATA

SOURCE: Adapted from DWR (1961).

The Bellflower aquiclude, in the Recent alluvium, consists of clay and sandy clay ranging from 10 to over 40 feet in thickness (Table 3-2). Beneath the Santa Fe Springs Plain, the Bellflower aquiclude is part of the undifferentiated Lakewood formation. Lack of data in many parts of the area, where the Lakewood formation is exposed at the surface, make it difficult to define the thickness, extent, and composition of this aquiclude. Where data are available, the Bellflower aquiclude is clay and sandy clay averaging 20 feet in thickness and extending down to a depth of about 70 feet below the ground surface. According to the Department of Water Resources (1961), the base of the Bellflower aquiclude as it occurs beneath Santa Fe Springs is approximately 100 feet above mean sea level (msl).

The degree to which groundwater can be transmitted through the Bellflower aquiclude depends on the thickness and composition of the aquiclude or the location and depth of improperly sealed oil and/or water wells. While the aquiclude appears to be continuous over most of the Whittier Area, it may be either absent in some areas or so thin and discontinuous that groundwater can be transmitted through it at an appreciable rate.

In addition to containing the Bellflower aquiclude, the Lakewood formation also contains the Artesia aquifer. The Artesia aquifer is mostly sand with some interbedded clay and near Santa Fe Springs has a maximum thickness of 20 feet. According the California Department of Water Resources (1961), the average elevation of the base of the Artesia aquifer beneath Santa Fe Springs is 80 feet msl.

The Gage aquifer is the major water-bearing member of the Lakewood formation in the Whittier Area. It has been delineated only in the southern portion of the area and near the Los Angeles-Orange County line, where it consists of about 30 feet of sand with some interbedded clay, and has a maximum depth of about 150 feet below ground surface (DWR 1961). The elevation of the base of the Gage aquifer is between 0 and 50 feet above mean sea level.

The San Pedro formation underlies the entire Whittier Area, where it attains a maximum thickness of about 850 feet and extends down to a depth below ground surface of about 920 feet. The formation is composed of sand and

TABLE 3-2

DEPTH, THICKNESS AND GEOLOGY OF AQUIFERS  
IN VICINITY OF WDI SITE

Formation	Water-Bearing Zone	Thickness (in feet)	Depth (in feet)	Upper Elevation (in feet $\pm$ msl)	Geologic Characteristics
Lakewood	Bellflower Aquiclude	10-40	70	+ 100	Clay and sandy clay
Lakewood	Artesia Aquifer	20 (max.)	--	+ 80	Sand, interbedded clay
Lakewood	Gage Aquifer	30	150	+ 0-50	Sand, interbedded clay
San Pedro	Hollydale Aquifer	10-25	100	+ 85-100	Sand and gravel, small amount of clay
San Pedro	Jefferson Aquifer	20-40	350	--	Sand and gravel, small amount of clay
San Pedro	Lynwood Aquifer	50-100	460	- 300 (at max. depth)	Sand and gravel, small amount of clay
San Pedro	Silverado Aquifer	100-200	650	- 500 (at max. depth)	Sand and gravel
San Pedro	Sunnyside Aquifer	150-200	1000	- 700 (at max. depth)	Sand and gravel, interbedded clay

Source: Adapted from DWR (1961).

gravel with interbedded clay, all probably of marine origin. Clay members separate the sands and gravels comprising the aquifers over most of the basin. The San Pedro formation contains the Hollydale, Jefferson, Lynwood, Silverado and Sunnyside aquifers. An extensive unconformity brings the aquifers of the San Pedro formation into contact with those of the Lakewood formation along the northern boundary of the area and along the edge of the Coyote Hills.

The Hollydale aquifer has been identified only in the western part of the Whittier Area. It may be present over the rest of the area, but data are lacking. It ranges in thickness from 10 to 25 feet and consists of sand and gravel with a small amount of interbedded clay. It appears to reach a maximum depth of about 100 feet below ground surface (elevation 50 feet msl). It is merged with the overlying Gage aquifer in the vicinity of south Whittier. If present beneath the WDI site, the Hollydale aquifer would first be encountered from 85 to 100 feet below ground surface.

The Jefferson aquifer ranges in thickness from 20 feet to 40 feet and consists of sand and gravel with a little interbedded clay. It extends over most of the Whittier Area and reaches a maximum depth of about 350 feet below ground surface (100 feet below sea level). In the western part of the area, near the boundary with the Montebello Forebay, the Jefferson aquifer merges with the overlying Hollydale aquifer.

The Lynwood aquifer is present throughout the Whittier Area. It ranges in thickness from 50 to 100 feet and consists of sand and gravel with some interbedded clay. It extends to a maximum depth of about 460 feet below ground surface (300 feet below sea level).

The Silverado aquifer has been identified over all of the Whittier Area. It consists of 100 to 200 feet of sand and gravel with finer grained phases in some areas. It extends to a depth of about 650 feet below ground surface (500 feet below sea level).

The Sunnyside aquifer also has been identified throughout the Whittier Area. It consists of 150 to 200 feet of sand and gravel with some interbedded clay.



It is the lowest of the aquifers identified, reaching a maximum depth of about 1,000 feet (700 feet below sea level). The gravels exposed in the Coyote Hills and along the north side of the area are believed to be surface outcrops of the Sunnyside aquifer.

As implied by the preceding discussion, as many as seven aquifers and one aquiclude may be present beneath the WDI site. The uppermost aquifer near WDI consists of recent alluvium which is as thick as 80 feet thick and is underlain by the Bellflower aquiclude. The permeability of the alluvium is from 50 gpd/ft<sup>2</sup> for sandy clay to 500 gpd/ft<sup>2</sup> for sand (Table 3-3). Groundwater occurs at approximately 50 feet below the ground surface.

### 3.5.2 Site-Specific Hydrogeology

The local hydrogeology is described based on information extracted from the boring logs and the water level elevations. The geologic features of the subsurface material have already been discussed in Section 3.4. The water level measurements are used mainly to estimate the groundwater flow direction within the WDI site.

In general, groundwater has been encountered at a depth of 46 to 65 feet below ground surface and from 91 to 106 feet above mean sea level. Accordingly, groundwater is approximately 34 to 44 feet below the bottom of the WDI reservoir and 22 to 47 feet below the bottom of the WDI waste handling areas. The general direction of the groundwater flow is to the southwest.

Groundwater level elevations at the WDI site were measured several times between September of 1988 and January 1989, although only two sets of measured water level elevations include a sufficient number of data points to develop water level contour maps. This data (Tables 3-4 and 3-5) represent the groundwater level elevations during November 1988 and January 19, 1989. The November 1988 data were obtained during groundwater well development and sampling over a period of one month while the January 19, 1989 data represent the data obtained during one day. Figures 3-17 and 3-18 are groundwater elevation maps constructed from the data. Note that the data

Figure 3-17  
**GROUNDWATER ELEVATION MAP**  
 NOVEMBER, 1988  
 WASTE DISPOSAL INC.

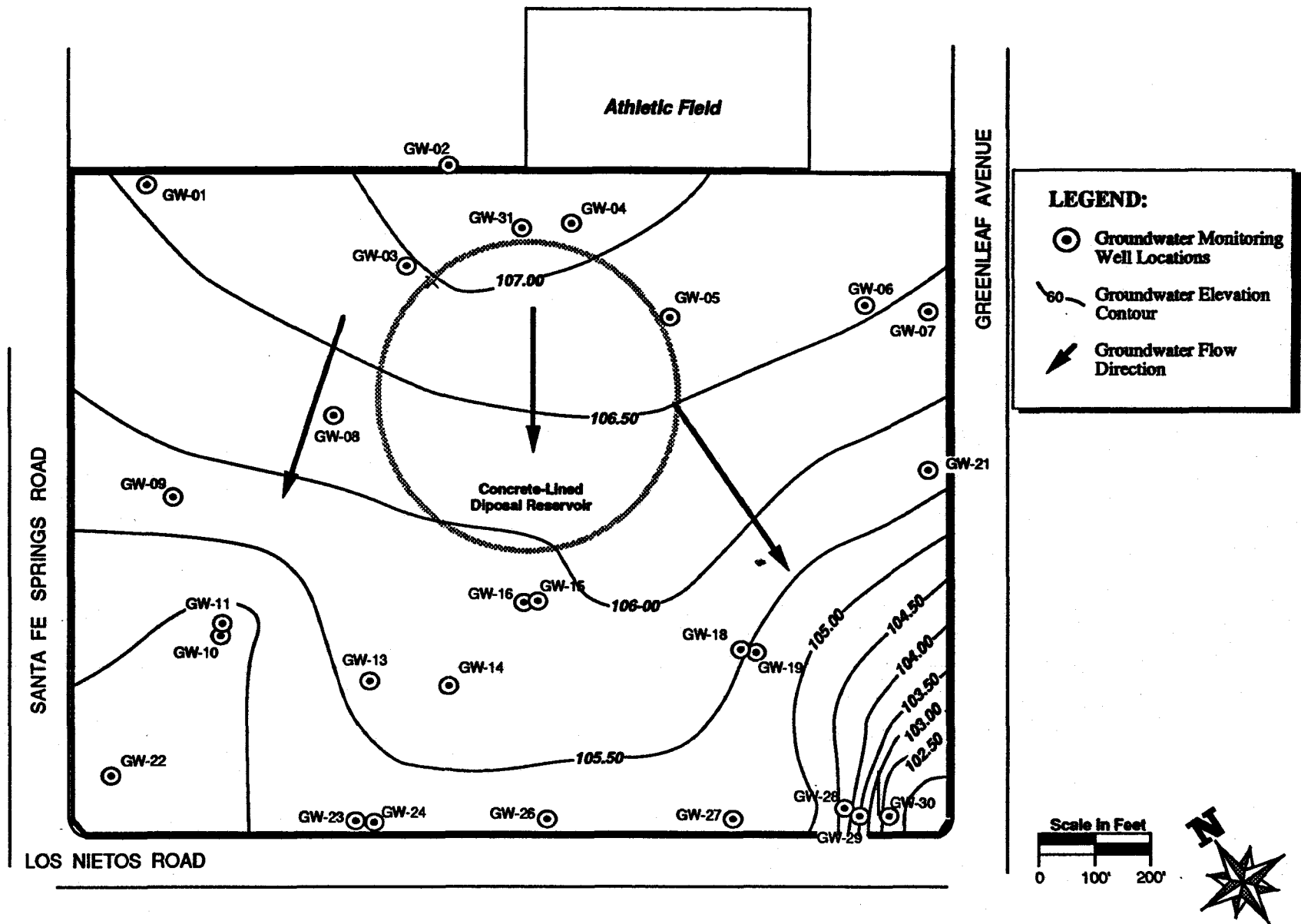


Figure 3-18  
**GROUNDWATER ELEVATION MAP**  
 JANUARY 19, 1989  
 WASTE DISPOSAL INC.

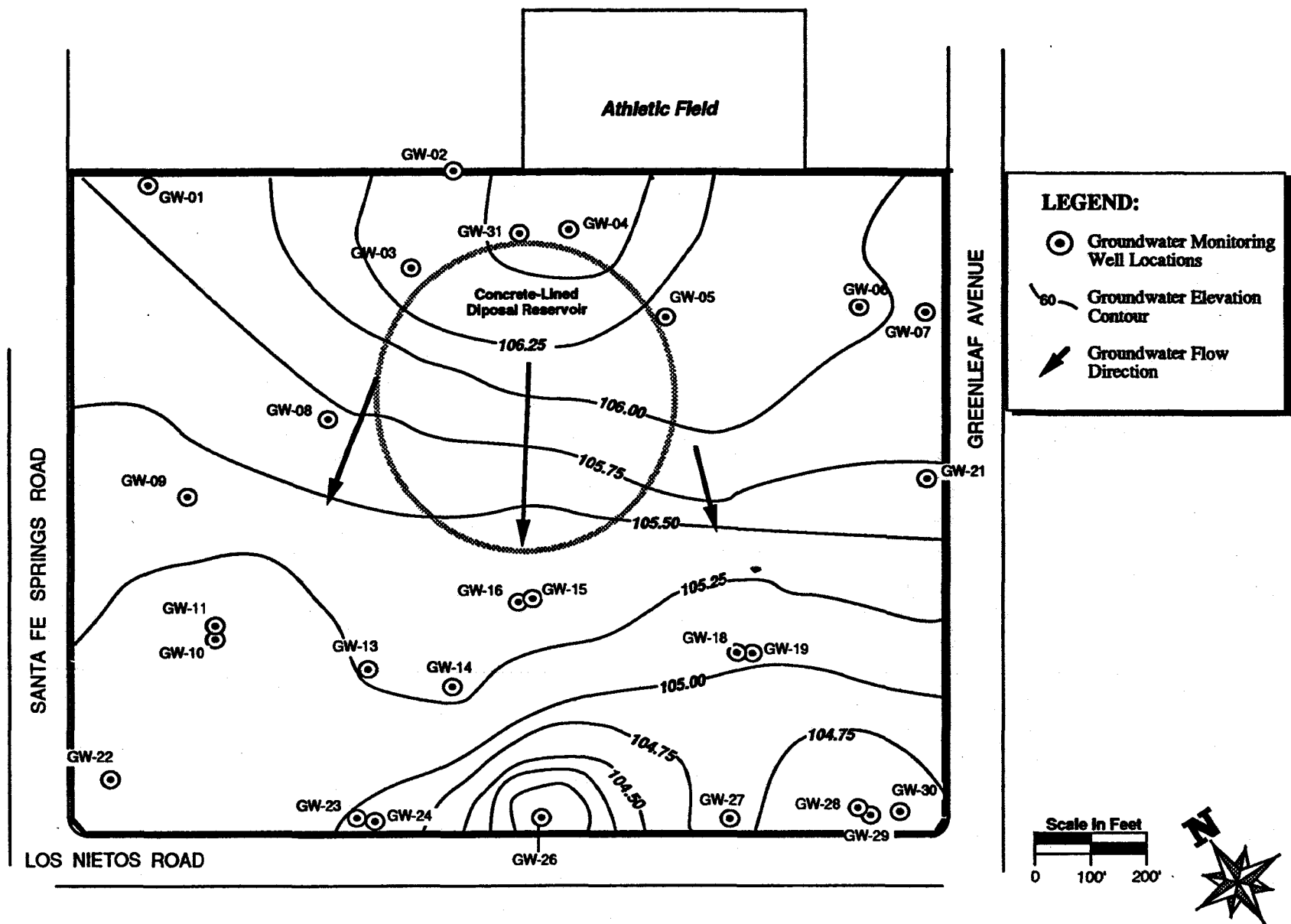


TABLE 3-3  
PERMEABILITY VALUES ASSIGNED TO AQUIFERS IN  
VICINITY OF WDI SITE

Media Type	Permeability Value
Sandy Clay (includes gravelly clay, clay and sand, clayey sand, etc.)	50 gpd/ft <sup>2</sup>
Sand	500 gpd/ft <sup>2</sup>
Gravel (includes sand and gravel)	
Gaspur Aquifer	4000 gpd/ft <sup>2</sup>
Ballona Aquifer	2000 gpd/ft <sup>2</sup>
Marine Gravels (Silverado, Sunnyside, and portion of Lynwood aquifers)	1500 gpd/ft <sup>2</sup>
Nonmarine Gravels (Gardena, Artesia, Exposition, Jefferson, Hollydale, and portion of Lynwood Aquifer)	1000 gpd/ft <sup>2</sup>
Gravel with Clay Streaks	one-half of above values for gravel
Clay	0

Source: Adapted from DWR (1961).

TABLE 3-4

## WATER LEVEL ELEVATIONS

NOVEMBER 1988

WASTE DISPOSAL, INC.

Well No.	Depth to Groundwater (Feet)	Water Level Elevation (Feet above msl)
GW-01	46.92	106.59
GW-02	46.16	107.29
GW-03	60.66	106.85
GW-04	59.68	107.07
GW-05	59.90	106.77
GW-06	51.82	106.56
GW-07	48.17	106.36
GW-08	48.17	106.28
GW-09	47.59	105.93
GW-11	49.95	104.78
GW-13	51.76	105.76
GW-14	51.87	105.89
GW-15	57.03	106.27
GW-19	53.22	105.67
GW-21	49.69	105.55
GW-22	64.98	91.71
GW-23	60.04	96.94
GW-26	50.77	105.27
GW-27	51.75	105.28
GW-28	52.35	104.96
GW-31	60.15	107.07

Note: Water level elevations for the intermediate and deep wells were not used for groundwater mapping and not included in this table.

TABLE 3-5

WATER LEVEL ELEVATIONS  
JANUARY 19, 1989  
WASTE DISPOSAL, INC.

Well No.*	Depth to Groundwater (Feet)	Water Level Elevation (Feet above msl)
GW-01	NA	NA
GW-02	NA	NA
GW-03	61.19	106.57
GW-04	60.21	106.80
GW-05	60.47	106.20
GW-06	52.34	106.04
GW-07	48.68	105.85
GW-08	57.63	105.75
GW-09	48.14	105.38
GW-11	49.67	104.99
GW-13	52.26	105.26
GW-14	52.34	105.33
GW-15	57.67	105.63
GW-19	53.71	105.45
GW-21	NA	NA
GW-22	NA	NA
GW-23	NA	NA
GW-26	52.41	103.63
GW-27	52.22	104.81
GW-28	52.82	104.81
GW-31	NA	NA

Note: NA = These wells were not accessible during the measurement day. Only water-level measurements from the shallow wells were reported here.

used in construction of these maps include only the data from shallow wells and as such represent conditions in the uppermost aquifer underlying the site.

Both water-level-elevation maps indicate that groundwater flow is generally in a southwest direction. These results are consistent with the findings in the 1985 Dames and Moore study. According to this data, near the Campbell property and the Dia-Log property, the flow is slightly to the south and to the west. This indicates that groundwater in these areas may possibly follow along narrow channels with higher permeabilities than the surrounding media.

The November 1988 data indicates a relatively low hydraulic gradient around the reservoir area sloping approximately 0.2 to 0.5 percent in the southwest direction that gradually increases in the direction of the Campbell property. The January 1989 data shows a hydraulic gradient of approximately 0.2 percent. The groundwater velocity could not be estimated since no aquifer test was planned for and conducted during the RI field investigations.

### 3.5.3 Regional Groundwater Use

Regional groundwater use within 3 miles of the WDI site has been classified based on the potential for surrounding populations to ingest contaminants from the WDI site. This approach has been taken to improve RI/FS effectiveness and performance of comprehensive risk assessment activities. This classification is intended as a screening tool to properly assign priorities and to evaluate the potential impacts to the most critical and/or susceptible elements of area groundwater supplies.

The classification of regional groundwater includes the following:

#### Priority 1

##### o Municipal

- Domestic or recreational use of first aquifer beneath site
- Domestic or recreational use of aquifer(s) which are hydraulically connected to first aquifer

- o Private Institution (School, Hospital, etc.)
  - Domestic or recreational use of first aquifer
  - Domestic or recreational use of hydraulically connected aquifers
- o Private Individual
  - Domestic or recreational use of first aquifer
  - Domestic or recreational use of hydraulically connected aquifers

#### Priority 2

- o Private Institution (Business, Farm, etc.)
  - Industrial, commercial or agricultural use of first aquifer
  - Industrial, commercial or agricultural use of hydraulically connected aquifers
- o Municipal
  - Industrial, commercial or agricultural use of first aquifer
  - Industrial, commercial or agricultural use of hydraulically connected aquifers
- o Private Individual
  - Industrial, commercial or agricultural use of first aquifer
  - Industrial, commercial or agricultural use of hydraulically connected aquifers

#### Priority 3

- o Domestic or recreational use of aquifer not hydraulically connected
- o Industrial, commercial, or agricultural use of aquifer not hydraulically connected
- o Other (i.e., subsurface storage of imported water)

Priority 1 groundwater wells in the area of the WDI site are described below:

- o Municipal water supply wells which utilize the first aquifer (shallowest groundwater) beneath the WDI site. At present, no nearby groundwater wells have been identified which are owned and/or operated by a municipality and which utilize groundwater from the first aquifer.



- o Municipal water supply wells which pump from aquifers hydraulically connected to the first aquifer. Although it has not been definitively established that the aquifers in the Lakewood formation are hydraulically connected naturally to those in the San Pedro formation, early researchers concluded that in the vicinity of the WDI site the aquifers within each of these formations may be hydraulically connected (Department of Water Resources 1961). The large number of oil wells in the area and the presence of multi-perforated groundwater wells may also act as artificial conduits of liquids between aquifers. Therefore, it is assumed that a well completed in any aquifer possesses a potential for being hydraulically connected to the first aquifer below the WDI site.

Four (4) out of the five (5) wells being used by the city of Santa Fe Springs to obtain 60 percent of its groundwater (40 percent is purchased from the Metropolitan Water District) are located within 3 miles of the WDI site. One of the wells is located downgradient of the WDI site. Both the groundwater from the city wells and that purchased from the Metropolitan Water District are fed directly into the same piping network for distribution (Price 1985a). A small amount of blending is done in a 4 million gallon reservoir. This system has 4200 connections including both residential and industrial.

- o Private institutions or individuals using first aquifer. Two wells located within 3 miles upgradient of the WDI site are known to have used the first aquifer at some time in the past but neither well is believed to be currently active.
- o Private institutions or individuals using aquifers hydraulically connected to the first aquifer. Nine area wells have been completed in an aquifer which may be hydraulically connected to the first aquifer. These wells are within 3 miles of the WDI site and four of these wells are located downgradient of the WDI. All of these wells are known to have been used at some time in the past. One well is believed to be abandoned. The status of the other eight wells is unknown at this time.

The exact location of the wells in the vicinity of the WDI site has been provided in the WDI's Groundwater Characterization Report (May, 1989). This information would be important for contaminant source identification and health risk assessment of any groundwater contamination study.

#### 4.0 NATURE AND EXTENT OF CONTAMINATION

The results of extensive chemical analyses of samples collected during the RI are used to describe the nature and extent of contamination at the WDI site. The extent of metals, volatile organics, semivolatile organics and pesticide/PCB compounds detected in the soils, groundwater and subsurface-gas samples have been evaluated based on the detection frequency, mean and standard deviation of data. These results are also used for the study of the fate and transport of contaminants in Section 5.0 and for the baseline risk assessment study in Section 6.0.

##### 4.1 SOURCES

The main potential source of contamination at WDI is the concrete-lined reservoir which contains concentrated volumes of various oil-field and industrial wastes. In addition, eight distinct areas have been identified as potential sources of subsurface contamination within the WDI study area. Several of these areas operated as unlined containment ponds for waste disposal whereas others may have received contaminant loads via surface runoff or subsurface migration pathways. All of these areas may contribute to the soil and/or groundwater contamination and are considered sources regardless of the manner in which contamination arose (Table 4-1). The Fedco/St. Paul's High School area located upgradient of the WDI site is less likely to have received contaminants from the WDI but its study provides background data on chemical concentrations of subsurface materials in the general WDI area.

##### 4.2 AIR QUALITY

High volume particulate samplers were used to determine baseline ambient particulate concentrations and its constituents (metals, organics, etc.). These same samplers were also used to evaluate any potential increases in the background conditions due to the RI activities. One of the 5 samplers was rotated every five days to one of the four permanent monitoring locations for the purpose of quality assurance. Data collected from the

TABLE 4-1

## CONTAMINANT SOURCE AREAS

Source Area	Description
Reservoir	The WDI concrete-lined reservoir used as main disposal pool for oil-sludge and industrial wastes.
1	Waste containment area along the western border where standing liquid was present according to the areal photos.
2	Waste containment area along the WDI reservoir perimeter where waste materials were disposed of during the reservoir overflow.
3	The eastern corner area covered by fill material but no indication of past waste disposal.
4	The northeast corner area where areal photos showed dark standing liquids.
5	The southeastern area covered on top by fill material but no visible contamination.
6	The southeastern corner area where standing liquids were seen over a small portion of the area.
7	The southern corner area in the Campbell property underlain by black oily soils and drilling muds.
8	The southwestern area where standing liquids were seen in areal photos and black sludge were found in certain parts of the site.
Fedco/St. Paul High School*	Upgradient areas which provide background chemical concentration data.

\*Not a contaminant source.

permanent samplers during the one-week baseline period are summarized in Table 4-2 and can be compared to the data collected during the RI activities (about 2 months) which are shown in Table 4-3. Analytical data from the quality assurance monitor samples were normally within a few percent of the values from the colocated permanent monitor samples. In general, neither the baseline nor the operating period particulate samples contained any detectable organics, with the exception of bis(2-ethylhexyl)phthalate which was found in all samples. Various metals were detected in all samples. However, there was no significant change in particulate concentrations or the inorganic or organic constituents of the samples collected between the baseline period and those during RI activities at the WDI site.

#### 4.3 SOIL CONTAMINATION

A comprehensive list of chemical constituents detected in soil samples from WDI, the compound concentrations, depth of sampling and other related information has been provided in Appendix B. The data have been reported under separate groups associated with the WDI Reservoir Area, Area 1 through 8 defined in Section 3.0 (see Figure 3-9) and the upgradient area including St. Paul's High School which provides background soil concentrations data. A data reduction/statistical analysis is performed on the exhaustive list of data to provide summary results which include such information as the frequency of detection, concentration range and arithmetic average values on a source-specific basis (see Appendix C). The arithmetic average values are generated for each analyte to provide input parameters for the risk assessment discussed in Section 6.0 of this report.

In the following discussions, first, an overview of chemical contamination found in soil samples is provided which identifies the concentration of Target Compound List (TCL) constituents within the WDI site and also compares this data with the background TCL concentrations from the upgradient area. Subsequently, the WDI subareas will be studied closely to identify the chemical compounds of concern within each specific subarea. The detailed data from the subareas are needed to identify the appropriate remediation technologies for these areas.

TABLE 4-2  
 AMBIENT CONCENTRATIONS OF PARTICULATES COLLECTED  
 DURING BASELINE PERIOD  
 (ug/m<sup>3</sup>)

	Low	High	Median	Arithmetic Mean
<b><u>SAMPLER WDI-01</u></b>				
AMBIENT TSP CONCENTRATION (ug/m <sup>3</sup> )	101.59	140.16	122.93	121.59
<b><u>INORGANICS</u></b>				
As	0.00161	0.0052	0.00406	0.003623
Cr	0.00687	0.01	0.0082	0.008357
Cu	0.0455	0.0569	0.0523	0.051567
Pb	0.0478	0.103	0.0698	0.073533
Se	0.000777	0.00185	0.000796	0.001141
<b><u>ORGANICS</u></b>				
bis(2-ethylhexyl)phthalate	0.0150	0.0178	0.0170	0.0166
<b><u>SAMPLER WDI-02</u></b>				
AMBIENT TSP CONCENTRATION (ug/m <sup>3</sup> )	98.9	125.47	117.14	114.8333
<b><u>INORGANICS</u></b>				
As	0.000612*	0.00191	0.00132	0.001291
Cr	0.00766	0.0136	0.0117	0.010987
Cu	0.0369	0.0562	0.0493	0.04747
Pb	0.0589	0.0914	0.0729	0.0744
Se	0.00101	0.00161	0.00141	0.013433
<b><u>ORGANICS</u></b>				
bis(2-ethylhexyl)phthalate	0.0121	0.0149	0.0126	0.0132
<b><u>SAMPLER WDI-03</u></b>				
AMBIENT TSP CONCENTRATION (ug/m <sup>3</sup> )	123.53	133.83	126.08	127.48
<b><u>INORGANICS</u></b>				
As	0.00059*	0.00307	0.00264	0.0021
Cd	0.00295	0.00357	0.00307	0.003197
Cr	0.00914	0.0137	0.0110	0.01128
Cu	0.0464	0.0577	0.0565	0.05353
Pb	0.0679	0.0957	0.08	0.0812
Se	0.00059*	0.00147	0.000928	0.000996
<b><u>ORGANICS</u></b>				
bis(2-ethylhexyl)phthalate	0.014	0.0216	0.0208	0.0188
<b><u>SAMPLER WDI-05</u></b>				
AMBIENT TSP CONCENTRATION (ug/m <sup>3</sup> )	99.25	123.99	109.48	111.74
<b><u>INORGANICS</u></b>				
As	0.00161	0.00316	0.00238	0.002383
Cr	0.00838	0.0145	0.0099	0.01093
Cu	0.0896	0.0947	0.0898	0.09137
Pb	0.0654	0.0966	0.0748	0.07893
Se	0.000611*	0.00186	0.000967	0.001146
<b><u>ORGANICS</u></b>				
bis(2-ethylhexyl)phthalate	0.0149	0.0467	0.0155	0.0257

\* Results were below detection limits or reported as a less than quantity.  
 Ambient concentrations are calculated using this detection limit.

TABLE 4-3  
 AMBIENT CONCENTRATIONS OF PARTICULATES COLLECTED  
 DURING RI ACTIVITIES  
 (ug/m<sup>3</sup>)

	Low	High	Median	Arithmetic Mean
<b><u>SAMPLER WDI-01</u></b>				
AMBIENT TSP CONCENTRATION (ug/m <sup>3</sup> )	38.5	210.0	93.9	96.77
<b><u>INORGANICS</u></b>				
Cr	0.0012	0.00926	0.0056	0.005388
Cu	0.0057	0.053*	0.032	0.029078
Hg	0.0000295*	0.0987	0.000145	0.0113351
Se	0.000306*	0.000642	0.00060	0.0005053
<b><u>ORGANICS</u></b>				
Benzoic Acid	0.0061*	0.0141	0.0064	0.008079
bis(2-ethylhexyl)phthalate	0.0061*	0.0283	0.0208	0.018835
<b><u>SAMPLER WDI-02</u></b>				
AMBIENT TSP CONCENTRATION (ug/m <sup>3</sup> )	67.44	199.0	110.84	114.74
<b><u>INORGANICS</u></b>				
As	0.000122	0.000858	0.0006395	0.0006479
Cr	0.00307*	0.0192	0.00687	0.007595
Cu	0.00791	0.0742	0.0312	0.032351
Pb	0.00581*	0.06	0.00985	0.019527
Se	0.0001	0.00128	0.0004695	0.0005535
<b><u>ORGANICS</u></b>				
Benzoic Acid	0.0061*	0.0171	0.00613	0.007507
bis(2-ethylhexyl)phthalate	0.011	0.0293	0.0189	0.01833
<b><u>SAMPLER WDI-03</u></b>				
AMBIENT TSP CONCENTRATION (ug/m <sup>3</sup> )	62.04	201.0	111.54	114.66
<b><u>INORGANICS</u></b>				
Cr	0.0003*	0.0326	0.00505	0.007409
Cu	0.00343	0.0577	0.0266	0.028993
Pb	0.00225	0.0742	0.006565	0.01815
Hg	0.000001	0.0007*	0.0000732	0.0001353
<b><u>ORGANICS</u></b>				
Benzoic Acid	0.0061*	0.0171	0.0064	0.007663
bis(2-ethylhexyl)phthalate	0.0129	0.281	0.0176	0.04636
<b><u>SAMPLER WDI-05</u></b>				
AMBIENT TSP CONCENTRATION (ug/m <sup>3</sup> )	43.2	200.0	111.67	112.24
<b><u>INORGANICS</u></b>				
As	0.0003*	0.00204	0.0006355	0.0009126
Cr	0.0015	0.0092	0.00566	0.005534
Cu	0.0031*	0.1165	0.0541	0.05772
Pb	0.0031	0.0706	0.00613	0.015952
Hg	0.0000288	0.0006*	0.0000913	0.0001351
Se	0.0001	0.0017	0.000358	0.0006277
<b><u>ORGANICS</u></b>				
Di-n-butylphthalate	0.0061*	0.0105	0.0062	0.006884
bis(2-ethylhexyl)phthalate	0.0005	0.0324	0.0182	0.01674

\* Results were below detection limits or reported as a less than quantity.  
 Ambient concentrations are calculated using this detection limit.

#### 4.3.1 Overview of Chemical Contamination

Of concern at the WDI site are the drilling muds and oil-field petroleum-based wastes appearing as black oily material or tar-like sludge. The waste materials were deposited in the WDI concrete-lined reservoir and its surrounding unlined containment ponds during the time of facility operation. The constituents of these waste materials include metals, volatile organics, semivolatile organics, pesticides, PCBs, and total petroleum hydrocarbons. The concentration of these constituents varies, but many are listed as hazardous according to the Resource Conservation and Recovery Act (RCRA) and Title 22 of the California Code of Regulations (CCR).

The concentration of various constituents in soil samples are compared against the California Department of Health Services Soluble Threshold Limit concentrations (STLC) and Total Threshold Limit Concentrations (TTLC). As defined in Title 22 of the CCR, STLC means the concentration of a solubilized and extractable bioaccumulative or persistent toxic substance which, if equaled or exceeded in a waste or waste extract determined pursuant to Section 66700 of CCR, renders the waste hazardous. STLC is defined in Title 22 of CCR as the concentration of a solubilized, extractable, and nonextractable bioaccumulative or persistent toxic substance which, if equaled or exceeded in a waste, renders the waste hazardous. Generally, comparing the soil's chemical concentrations to STLC gives a very rough idea of whether the contamination may be of concern due to leachability.

None of the concentrations of the constituents except lead exceed the California Department of Health Services total threshold limit concentrations (TTLC) for hazardous waste in soil. Several compounds exceed the California Department of Health Services soluble threshold limit concentration (STLC). Several compounds also exceed background concentrations.

During sampling, a limited number of samples containing visible levels of contamination were marked as medium- and high-contaminant samples and submitted for laboratory analysis. When these samples were analyzed in the laboratory, the detection limits were raised to reflect the expected level of contamination in these samples. Whenever compound concentrations of



these samples fell below the detection limits, the reported concentration was set at detection limits. No additional analyses at lower detection limits were performed to estimate the concentration of these compounds. Therefore, some uncertainty exists about the compound concentrations of medium- and high-level samples reported with less than detection limit concentrations. To reduce the amount of bias toward unreasonably large values that could have been created by including high detection limits, during statistical analysis of data only samples showing above detection limit concentrations are considered.

Among statistical data presented here are the geometric and arithmetic means, standard deviation and the frequency of detection which represents the percentage of data showing above detection limit concentrations. The frequency of detection of each compound is an important measure of the extent of contamination by that particular compound.

Of the 24 metals analyzed, all are present in WDI soil (Table 4-4 and Appendices B and C). None of the concentrations of metals except lead exceed the TTLC although the mean concentrations of arsenic, barium, cadmium, copper, lead, thallium, and vanadium consistently exceed the STLC. All metals except silver have concentrations above the background values.

Twenty-six (26) volatile organic compounds are present in the soil samples from the WDI site (Table 4-5 and Appendices B and C). The detection frequency of volatile organics are generally very low. Only six compounds, toluene, methylene chloride, acetone, 2-butanone, ethylbenzene and xylene, have detection frequencies greater than 10 percent. Of these, methylene chloride and acetone are known as common laboratory contaminants. The high standard deviation of volatile organic compounds in Table 4-6 is indicative of large variation in data. The detectable volatile organics have been derived for the most part from samples from depths of 0 to 35 feet. The six compounds mentioned above have, however, been found in samples from depths of 0 to 60 feet. Deep penetration of these compounds has potential for contamination of groundwater.

TABLE 4-4  
METALS CONCENTRATIONS COMPARED TO BACKGROUND  
WDI RESERVOIR/WASTE HANDLING AREAS

Metals	Background Concentrations (mg/kg)	Frequency of Detects (%)	Minimum (ppm)	Maximum (ppm)	Median (ppm)	Standard Deviation (ppm)	Arithmetic Mean (ppm)	Geometric Mean (ppm)	STLC Values (ppm)	TTLT Values (ppm)
Aluminum, Al	3,450.00 - 10,300.00	100.00	3,000	39,600	12,600	6,867	12,954	10,969	b	c
Antimony, Sb	2.70 - 3.00	49.82	2	173	4.65	14.62	6.08	4.43	15.00	500.00
Arsenic, As	1.68 - 2.31	100.00	.71	337	5.45	21.91	8.74	5.36	5.36	500.00
Barium, Ba	37.50 - 71.10	100.00	29.8	4,450	150	506.22	267.55	145.36	100.00	10,000.00
Beryllium, Be	0.196 - 0.278	85.66	0.13	1.4	0.35	0.35	0.55	0.42	0.75	75.00
Cadmium, Cd	0.255 - 0.363	57.04	0.19	50.1	0.68	4.62	1.45	0.71	1.00	100.00
Calcium, Ca	1,360.0 - 1,870.0	100.00	1,280	92,400	4,285	12,837	8,986	5,208	b	c
Chromium, Cr	5.96 - 12.10	100.00	4.63	149	22.75	15.14	23.68	19.53	560.00	2,500.00
Cobalt, Co	3.00 - 7.17	99.64	2.46	31.8	11.25	5.44	11.17	9.67	80.00	8,000.00
Copper, Cu	4.95 - 13.80	99.29	3.44	721	24.1	64.98	35.37	22.3	25.00	2,500.00
Iron, Fe	6,130.00 - 13,700.00	100.00	5,350	61,600	20,600	8,974	20,170	17,890	b	c
Lead, Pb	3.33 - 7.00	99.64	1.5	2,790	7.3	305	82.55	11.59	5.00	1,000.00
Magnesium, Mg	1,660.00 - 3,220.00	100.00	1,440	27,200	5,985	3,380	6,193	5,307	b	c
Manganese, Mn	88.80 - 263.00	100.00	71.8	2,270	342	271.5	393.86	325.21	b	c
Mercury, Hg	0.018 - 0.0137	72.86	0.01	10.9	0.11	0.79	0.21	0.09	0.20	20.00
Molybdenum, Mo	0.194 - 0.268	47.65	0.19	33.4	0.55	3.01	1.24	0.72	350.00	3,500.00
Nickel, Ni	4.05 - 9.23	100.00	3.61	105	18.9	11.43	18.62	15.34	20.00	2,000.00
Potassium, K	818.00 - 2260.00	100.00	495	13,600	3,490	1,664	3,266	2,770	b	c
Selenium, Se	0.202 - 0.278	48.01	0.13	1.2	0.26	0.24	0.36	0.31	1.00	100.00
Silver, Ag	0.863 - 0.939	45.49	0.42	4.8	0.81	0.63	0.90	0.80	5.00	500.00
Sodium, Na	123.00 - 231.00	87.32	88.7	6,650	465	955.05	781.59	486.03	b	c
Thallium, Tl	9.77 - 12.00	41.52	0.55	39.2	12.6	5.77	14.34	13.07	7.00	700.00
Vanadium, V	10.60 - 27.30	100.00	9.33	107	40.3	17.55	38.80	34.11	24.00	2,400.00
Zinc, Zn	22.10 - 38.30	100.00	14	775	61.6	93.15	81.77	58.56	250.00	5,000.00

<sup>a</sup> Neither the waste extraction test (WET) to determine the STLC nor the EP Toxicity test have been conducted on WDI soil samples at this time. These values are provided for reference purposes only. Generally, if the concentration of a metal is 10 times the STLC or EP Toxicity test in soil it can be considered likely to occur in hazardous concentrations in leachate.

<sup>b</sup> Soluble Threshold Limit Concentrations (STLC) values have not been established for these metals under Title 22 of the California Code of Regulations (CCR).

<sup>c</sup> Total Threshold Limit Concentrations (TTLT) values have not been established for these metals under Title 22 of the California Code of Regulations (CCR).

TABLE 4-5

VOLATILE ORGANIC COMPOUNDS (VOC) CONCENTRATIONS  
WDI RESERVOIR/WASTE-HANDLING AREA

Compound	Depth	Number of Detects	Number of Samples	Frequency of Detects (%)	STLC Values (mg/l)	Minimum (ppb)	Maximum (ppb)	Median (ppb)	Standard Deviation (ppb)	Arithmetic Mean (ppb)	Geometric Mean (ppb)
1,1,1-Trichloroethane	5,10,15,20,30,35	13	304	4.28	a	3	1,800	9	733.46	512.54	45.98
1,1,2,2-Trichloroethane	20	1	58	1.72	a	28	28	28	0	28.00	28.00
1,1,2-Trichloroethane	20	1	60	1.67	a	16	16	16	0	16	16
1,1-Dichloroethene	5,10,20,35	4	240	1.67	a	2	1,200	34.5	588.93	317.75	26.26
1,2-Dichloroethene	0,10,15,20	4	204	1.96	a	1.7	14	8.5	6.23	8.18	5.93
1,2-Dichloropropane	20	1	60	1.67	a	17	17	17	0	17	17
2-Butanone	0-50	93	398	23.37	a	1	11,000	12	1,139.02	148.03	14.41
2-Hexanone	10	1	62	1.61	a	3	3	3	0.00	3.00	3.00
4-Methyl-2-Pentanone	0,5,10,20	8	226	3.54	a	1	68	4.5	23.00	14.13	5.56
Acetone <sup>b</sup>	0-50	70	263	26.62	a	1	4,100	38.5	514.83	173.14	46.22
Benzene <sup>c</sup>	0-35	36	412	8.74	a	0	19,000	195	4,099.00	2,200.00	97.00
Benzyl Alcohol	35	1	68	1.47	a	89	89	89	0	89.00	89.00
Carbon Disulfide	5,10,15	4	152	2.63	a	1	10	5.5	3.87	5.5	4.09
Carbon Tetrachloride	10	1	62	1.61	a	2	2	2	0.00	2.00	2.00
Chlorobenzene	20	2	60	3.33	a	18	70	44	36.67	44.00	35.50
Chloroform	0-25	10	263	3.80	a	1	5	2	1.25	2.00	1.73
Chloromethane	5	1	48	2.08	a	2	2	2	0	2	2
Ethylbenzene <sup>c</sup>	0-35,50	67	418	16.03	a	1	73,000	230	10,886.19	4,995.87	202.12
Methylene Chloride <sup>b</sup>	0-50	82	250	32.80	a	1	2,400	8	386.00	140.00	14.00
Styrene	10,20	5	124	4.03	a	1	650	17	282.39	145.60	23.89
Tetrachloroethene	5-20	9	213	4.23	a	2	43,000	6	14,286.31	4,917.67	25.68
Toluene <sup>b,c</sup>	0-50,60	232	442	52.49	a	0.3	120,000	36.5	9,546.05	1,853.43	42.41
Trichloroethene <sup>c</sup>	10,15,20,35	7	235	2.98	204	1	5,000	21	1,859.90	806.43	28.67
Vinyl Acetate	0,40,45	3	65	4.62	a	9	76	64	35.73	49.67	35.24
Vinyl Chloride	10,15	3	110	2.73	a	1	1,700	18	976.00	573.00	31.00
Xylene <sup>c</sup>	0-35,60	52	410	12.68	a	2	410,000	515	71,250.61	24,236.68	441.93

<sup>a</sup> STLC Values have not been established for these chemicals under Title 22 of the California Code of Regulations (CCR).<sup>b</sup> Common laboratory contaminant.<sup>c</sup> Constituents commonly found in total petroleum hydrocarbon.

TABLE 4-6

SEMI-VOLATILE ORGANICS CONCENTRATIONS  
WDI RESERVOIR/WASTE-HANDLING AREAS

Compound	Depth	Number of Detects	Number of Samples	Frequency of Detects (%)	STLC Values (mg/l)	Minimum (ppb)	Maximum (ppb)	Median (ppb)	Standard Deviation (ppb)	Arithmetic Mean (ppb)	Geometric Mean (ppb)
1,2,4-Trichlorobenzene	0,10,20,30	5	193	2.59	a	35	2,600	98	1,114.89	611.00	174.22
1,2-Dichlorobenzene	5,10,20	4	170	2.35	a	3	1,600	203.5	753.30	502.50	75.11
1,3-Dichlorobenzene	10	1	60	1.67	a	24	24	24	0.00	24.00	24.00
1,4-Dichlorobenzene	5,10,20	5	156	3.21	a	6	2,400	160	1,009.00	687.00	165.00
2,4-Dinitrotoluene	10	1	57	1.75	a	130	130	130	0.00	130.00	130.00
2,6-Dinitrotoluene	10	1	59	1.69	a	360	360	360	0.00	360.00	360.00
2-Chloronaphthalene	20	1	56	1.79	a	20	20	20	0.00	20.00	20.00
2-Chlorophenol	20,30	3	83	3.61	a	71	5,200	160	2,395.87	1,810.33	389.46
2-Methylnaphthalene	0-35,45,50,60	83	440	18.86	a	2	170,000	1200	32,293.77	14,573.77	1099.56
2-Methylphenol	0	1	50	2.00	a	79	79	79	0.00	79.00	79.00
3,3-Dichlorobenzidine	5,10	2	100	2.00	a	93	100	96.5	4.95	96.5	96.44
4-Chloro-3-methylphenol	0,10,20,30,35	6	260	2.31	a	73	5,300	145	2,107.60	1,000.00	234.58
4-Chloroaniline	5	1	48	2.08	a	140	140	140	0.00	140.00	140.00
4-Methylphenol	0,15,35	4	158	2.53	a	110	1200	715	451.70	685.00	507.87
4-Nitroaniline	5	1	46	2.17	a	82	82	82	0	82	82
4-Nitrophenol	35	5	136	3.68	a	80	1,700	780	582.05	806.00	562.57
Acenaphthene	0-30,50	14	305	4.59	a	2.7	2,300	130	914.56	669.98	151.65
Acenaphthylene	5,10,35	4	158	2.53	a	18	170	77.5	63.00	85.75	65.36
Anthracene	0-20	12	272	4.41	a	5	16,000	171	4,525.00	1,731.00	161.00
Benzo(a)anthracene	0,5,10,15,20	13	303	4.29	a	27	1,500	360	430.00	446.00	274.00
Benzo(a)pyrene	0-20,35	16	373	4.29	a	18	1,500	205	399.65	365.88	212.03
Benzo(b)fluoranthene	0-10,35	10	252	3.97	a	45	2,200	325	626.61	470.50	283.85
Benzo(g,h,i)perylene	0-10,35	8	228	3.51	a	51	660	170	252.27	288.63	191.00
Benzo(k)fluoranthene	0-10	5	152	3.29	a	48	410	120	162.07	201.80	148.85
Benzoic Acid	0-10,25,35	11	288	3.82	a	69	1,700	100	568.31	320.36	174.34
Butylbenzylphthalate	0,5,20,30,40,60	12	192	6.25	a	18	17,000	195	4,831.11	1,885.95	259.36
Chrysene	0-35	40	419	9.55	a	2	8,000	285	1,688.00	871.00	234.00

TABLE 4-6

SEMI-VOLATILE ORGANICS CONCENTRATIONS  
WDI RESERVOIR/WASTE-HANDLING AREAS  
(Continued)

Compound	Depth	Number of Detects	Number of Samples	Frequency of Detects (%)	STLC Values (mg/l)	Minimum (ppb)	Maximum (ppb)	Median (ppb)	Standard Deviation (ppb)	Arithmetic Mean (ppb)	Geometric Mean (ppb)
Di-n-butylphthalate	0-35	37	369	10.03	a	4	8,600	220	1,414.66	619.54	238.48
Di-n-octylphthalate	0-25,35	15	356	4.21	a	31	88,000	120	22,681.89	6,011.67	165.20
Dibenzofuran	0-20	9	251	3.59	a	3	1,300	280	435.67	383.78	98.06
Dibenz(a,h)anthracene	5,10	2	100	2.00	a	16	42	29	18.38	29	25.92
Diethylphthalate	15,35	3	105	2.86	a	22	360	48	188.09	143.33	72.44
Dimethylphthalate	0	1	50	2.00	a	1000	1,000	1,000	0	1,000.00	1,000.00
Fluoranthene	0-20	24	307	7.82	a	2.1	1,500	170	441.40	369.68	115.92
Fluorene	0-35	43	391	11.00	a	2	18,000	250	3,856.00	2,168.00	269.00
Hexachloroethane	15	1	40	2.50	a	280	280	280	0	280.00	280.00
Ideno(1,2,3-cd)pyrene	5,10,35	5	176	2.84	a	58	450	89	163.96	174.20	128.01
Isophorone	0,10,15	3	75	2.67	a	62	3,200	150	1,787.00	1,137.00	310.00
N-Nitrosodiphenylamine	5-15,25,30,35	7	250	2.80	a	90	4,000	950	1,326.00	1,247.00	731.00
Naphthalene	0-35,45,50,60	62	439	14.12	a	3.3	52,000	665	11,913.74	6,261.49	681.55
Nitrobenzene	10	1	57	1.75	a	20	20	20	0.00	20.00	20.00
Pentachlorophenol	0-10,30,35	7	238	2.94	a	180	340	230	59.64	257.14	251.26
Phenanthrene	0-35,45,50	67	422	15.88	a	5	44,000	550	8,959.50	4,341.60	552.04
Phenol	0,15,20	4	152	2.63	a	51	4,800	2800	2,057.00	2,613.00	1,152.00
Pyrene	0-35,60	41	424	9.67	a	2.5	4,300	180	941.35	623.63	164.57
bis(2-Ethylhexyl)phthalate	0-35	61	335	18.21	a	4	830,000	150	106,219.00	14,028.00	195.00

<sup>a</sup> STLC values have not been established for these chemicals under Title 22 of the California Code of Regulations (CCR).

Forty-six (46) semivolatile organic compounds are present at the WDI site (Table 4-6 and Appendices B and C). Six (6) compounds, di-n-butylphthalate, fluorene, naphthalene, phenanthrene, bis (2-ethylhexyl) phthalate and 2-methylnaphthalene, have detection frequencies greater than 10 percent. The most frequently detected semivolatile compound is 2-methylnaphthalene with detection frequency of 18 percent. Pyrene, phenanthrene, naphthalene and 2-methylnaphthalene were found below 35 feet and are potential sources of groundwater contamination. Naphthalene, 2-methylnaphthalene, benzo(a)anthracene, anthracene, chrysene, benzo(a)pyrene, benzo(k)fluoranthene, fluorene, benzo(b)fluoranthene, pyrene, pentachlorophenol, and phenanthrene are consistently present in the surface soil.

Eighteen (18) pesticides/PCBs are present at the WDI site (Table 4-7 and Appendices B and C). Five (5) pesticides including DDD, DDE, DDT alpha-chlordane and gamma-chlordane have detection frequencies between 5 and 8 percent. Detection frequencies of PCBs are less than 4 percent. None of these contaminants are consistently present at depths greater than 4 feet below ground level. Alpha-chlordane, gamma-chlordane, dieldrin, DDD, DDE and DDT are the only pesticides consistently present on the ground surface.

Total petroleum hydrocarbons (TPH) are the major contaminant at the WDI site. No soil samples were collected for laboratory analysis of TPH but soil from many areas of the WDI reservoir and waste handling areas were visibly contaminated. Analysis of soil samples were performed with an on-site infra-red (IR) spectrometer; however, the samples which were analyzed with this instrument were not collected from the reservoir or waste handling areas (Table 4-8). Note that the Comprehensive Environmental Response and Cleanup Liability Act (CERCLA or Superfund) does not recognize TPH as a hazardous substance; while California regulatory agencies (the Department of Health Services and Regional Water Quality Control Boards) generally recognize any TPH over 1,000 parts per million (ppm) as hazardous and many of these agencies require monitoring and/or venting of soils with TPH values which exceed 100 ppm, the state of California does not have a promulgated standard for TPH.

TABLE 4-7

PESTICIDES/PCBS CONCENTRATIONS  
WDI RESERVOIR/WASTE-HANDLING AREAS

Compound	Depth	Number of Detects	Number of Samples	Frequency of Detects (%)	STLC Values (mg/l)	Minimum (ppb)	Maximum (ppb)	Median (ppb)	Standard Deviation (ppb)	Arithmetic Mean (ppb)	Geometric Mean (ppb)
4,4'-DDD	0-20,35	21	350	6.00	0.1	2	62,000	36	13,454.72	3,436.26	67.42
4,4'-DDE	0-20,35	22	336	6.55	a	0.8	30,000	20	6,377.92	1,452.30	31.21
4,4'-DDT	0,5,10,30,35	20	255	7.84	a	3	260,000	51	58,109.52	13,121.48	66.55
Aldrin	5	1	51	1.96	a	23	23	23	0	23.00	23.00
Aroclor-1242	5	1	47	2.13	a	80	80	80	0	80.00	80.00
Aroclor-1248	0,10,20,25	5	179	2.79	5.0	22	23,000	1,700	11,283.98	8,758.80	1,033.9
Aroclor-1254	10,15,20,25,35	7	252	2.78	a	31	570	120	193.96	190.29	774.52
Aroclor-1260	0,5,20,35	7	218	3.21	a	100	3,200	530	1,410.18	1,228.57	536.98
Dieldrin	0,10	4	103	3.88	0.8	8	35	22.5	11.40	22.00	193.29
Endosulfan II	0	2	43	4.65	a	120	280	200	113.14	200.00	183.30
Endrin	5,20	2	114	1.75	0.02	1.3	14	7.5	9.19	7.50	3.74
Heptachlor	20,35,45	5	145	3.45	0.87	2	87	3	36.78	22.20	7.08
Heptachlor epoxide	0	2	43	4.65	a	2.5	46	24	31.11	24.00	9.59
alpha-BHC	35,40	2	86	2.33	a	1	2	1.5	.71	1.5	1.41
alpha-Chlordane	0,5,35	8	158	5.06	0.25	1	860	15.5	298.41	177.13	29.93
delta-BHC	10	2	60	3.33	a	230	980	605	530.33	605.00	474.75
gamma-BHC (Lindane)	10,35	3	128	2.34	0.4	7	15	8	4.36	10.00	9.44
gamma-Chlordane	0,5,20,35	15	231	6.49	a	1	1,200	12	337.34	211.40	27.78

<sup>a</sup> STLC Values have not been established for these chemicals under Title 22 of the California Code of Regulations (CCR).

TABLE 4-8  
TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN SOIL  
WASTE DISPOSAL INCORPORATED <sup>a</sup>

Sample ID <sup>b</sup>	Concentration (mg/kg)
SB-018-1.5	345
SB-018-15	6106
SB-018-20	1184
SB-019-15	492
SB-019-15	334
SB-019-20	369
SB-019-35	350
SB-020-35	750
SB-026-04	1356
SB-026-08	248
SB-026-12	181
SB-026-16	178
SB-026-20	*199
SB-033-05	7798
SB-033-10	2848
SB-033-15	482
SB-033-20	449
SB-033-35	0
SB-037-1.5	543
SB-053-05	317
SB-053-1.5	1887
SB-053-10	275
SB-053-15	236
SB-053-20	618
SB-053-25	248
SB-055-05	150
SB-055-10	1146
SB-055-15	14851
SB-055-20	8721
SB-055-35	2736
SB-055-35	344
SB-056-0	4085
SB-056-10	292
SB-056-20	275
SB-056-25	498
SB-056-30	315
SB-056-35	299
SB-067	650

<sup>a</sup> These concentrations were detected using an infrared spectrometer (a field instrument) with data quality objective (DQO) level 1 (screening). Because the quality of this data cannot be documented through data validation, it will not be used in the RI/FS conclusions for this site.

<sup>b</sup> The first number in this sequence is the boring location. The second number is the sample depth.



#### 4.3.2 Chemical Characteristics of Subareas

This section describes the chemical characteristics of each subarea within the WDI site. The discussions are focused on chemical compounds that may be of health risk concern. The information provided includes the detection frequency of each compound, the compound concentration range, and the average concentration from all borings and all depths. The specific data on samples collected at different depths in each boring have been provided in Appendix B.

The WDI Reservoir - Table 4-9 includes a summary of chemical analyses results on analytes that are of health risk concern. As expected, the reservoir area is the most contaminated area within the WDI site. Seven (7) metals, seven (7) volatile organics, eighteen (18) semi-volatile organics and ten (10) pesticides/PCB's of concern were found in the soil samples analyzed. Among metals of concern, arsenic, cadmium, copper, lead and mercury were present in concentrations above the STLC and lead was present in concentrations above the TTLC. The detected volatile organics of concern include 2-butanone, acetone, benzene, ethylbenzene, methylene chloride, toluene and xylene. These compounds were found in 13 to 50 percent of the samples analyzed. Benzene, toluene, ethylbenzene and xylene are constituents of various petroleum hydrocarbons. Acetone, chloroform and methylene chloride are common laboratory contaminants. Semi-volatile organics of concern were detected in less than 49 percent of the soil samples analyzed. Fluoranthene, fluorene, naphthalene, phenanthrene, pyrene and bis(2-ethylhexyl)phthalate were the most frequently detected semi-volatiles. Pesticides/PCB's of concern were found in less than 14 percent of the samples analyzed.

There are elevated levels of metals, semi-volatile organics, and volatile organic compounds in the soils within the reservoir. The 5 to 15 feet of fill material covering the waste material in the reservoir is relatively free of contamination. Below the fill and within the waste itself, lead, barium, beryllium, arsenic, cadmium, copper, nickel, mercury, thallium and vanadium are found throughout the reservoir. Of these, the concentrations of lead, barium and arsenic consistently exceed the STLC. Of the semi-volatile and volatile organic compounds identified within the waste,

TABLE 4-9

CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN THE RESERVOIR AREA

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
● Metals				(ppm)	(ppm)	(ppm)
Arsenic	41	41	100	1.80	337.00	23.20
Cadmium	41	22	51	0.39	18.20	2.30
Chromium	41	41	100	8.26	149.00	34.67
Copper	41	41	100	7.30	721.00	57.45
Lead	41	41	100	4.80	23,000.00	822.20
Mercury	41	29	71	0.02	10.90	0.61
Selenium	41	17	41	0.20	0.87	0.41
● Volatile Organics				(ppb)	(ppb)	(ppb)
2-Butanone	38	5	13	1.00	13.00	6.00
Acetone	28	7	25	1.00	4,100.00	779.00
Benzene	47	15	32	1.80	19,000.00	3,727.00
Chloroform	41	0	0	N/A	N/A	N/A
Ethylbenzene	52	26	50	1.20	73,000.00	7,895.00
Methylene Chloride	26	12	46	1.00	1,200.00	249.00
Toluene	44	35	79	0.80	120,000.00	8,189.00
Xylene (total)	49	24	49	4.10	410,000.00	38,594.00
● Pesticides and PCB's				(ppb)	(ppb)	(ppb)
4,4'-DDD	43	4	9	2.00	28.00	10.60
4,4'-DDE	43	4	9	4.00	44.00	17.80
4,4'-DDT	43	4	9	15.00	72.00	43.80
Aldrin	43	0	0	N/A	N/A	N/A
Aroclor-1016	41	0	0	N/A	N/A	N/A
Aroclor-1221	41	0	0	N/A	N/A	N/A
Aroclor-1232	41	0	0	N/A	N/A	N/A
Aroclor-1242	41	0	0	N/A	N/A	N/A
Aroclor-1248	50	1	2	22.00	22.00	22.00
Aroclor-1254	41	3	14	86.00	570.00	329.00
Aroclor-1260	46	3	7	100.00	3,200.00	1,533.00
Dieldrin	43	1	2	7.80	7.80	7.80
Heptachlor	43	0	0	N/A	N/A	N/A
Heptachlor epoxide	43	2	5	2.50	46.00	24.30
Toxaphene	41	0	0	N/A	N/A	N/A
alpha-BHC	43	0	0	N/A	N/A	N/A
alpha-Chlordane	43	2	5	9.10	210.00	110.00
beta-BHC	43	0	0	N/A	N/A	N/A
delta-BHC	43	0	0	N/A	N/A	N/A
gamma-BHC (Lindane)	43	0	0	N/A	N/A	N/A
gamma-Chlordane	43	2	5	12.00	270.00	141.00
● Semi-Volatiles Organics				(ppb)	(ppb)	(ppb)
Acenaphthene	50	9	18	2.70	2,300.00	504.00
Acenaphthylene	49	1	2	18.00	18.00	18.00
Anthracene	50	6	12	5.00	260.00	65.00
Benzo(a)anthracene	50	2	4	27.00	600.00	314.00
Benzo(a)pyrene	50	2	4	18.00	280.00	149.00
Benzo(b)fluoranthene	44	2	5	310.00	410.00	360.00
Benzo(g,h,i)perylene	44	1	2	560.00	560.00	560.00
Benzo(k)fluoranthene	44	2	5	340.00	410.00	375.00
Benzoic Acid	44	3	7	100.00	1,700.00	640.00
Chrysene	50	9	18	2.20	7,400.00	1,219.00
Di-n-butylphthalate	49	4	8	4.00	230.00	84.00
Di-n-octylphthalate	44	1	2	630.00	630.00	630.00
Dibenz(a,h)anthracene	44	0	0	N/A	N/A	N/A
Fluoranthene	50	10	20	2.30	1,300.00	466.00
Fluorene	52	17	33	2.00	8,100.00	1,315.00
Indeno(1,2,3-cd)pyrene	44	0	0	N/A	N/A	N/A
Naphthalene	52	23	44	3.30	52,000.00	8,567.00
Pentachlorophenol	44	0	0	N/A	N/A	N/A
Phenanthrene	51	25	49	5.70	44,000.00	6,195.00
Pyrene	51	12	24	3.20	2,900.00	860.00
bis(2-ethylhexyl)phthalate	40	13	33	3.60	2,100.00	354.00

2-methylnaphthalene, naphthalene, phenanthrene, benzene, ethylbenzene, xylene, and toluene are most prevalent. The concentrations of contaminants in soil samples collected from below the wall and base of the reservoir in SB-026 and SB-059, respectively are relatively low. Conversely, soil samples taken immediately below the base of the reservoir from SB-057 show elevated levels of many of the compounds found within the reservoir.

Area 1 - Table 4-10 summarizes the results of chemical analyses of compounds of concern from the soil samples collected in Area 1. Seven (7) metals, six (6) volatile organics, seventeen (17) semi-volatile organics, and seven (7) pesticide compounds of concern were detected in this area. The highest detection frequencies were observed in metals (75 to 100 percent) and volatile organics (2 to 47 percent). Average concentrations of arsenic, cadmium, copper and lead were above STLC levels. Toluene, acetone, methylene chloride and 2-butanone were the only volatile organics detected in more than 10 percent of the samples analyzed. The maximum detection frequencies of semi-volatile organics and pesticides of concern were respectively 12 and 8 percent indicating that these compounds were found in only a few samples.

The highest concentrations of metals were found for barium, calcium, iron and magnesium (all present in various oil field drilling muds). In Area 1, the concentrations of arsenic, barium, beryllium, cadmium, mercury, copper, lead, nickel, thallium, vanadium and zinc at times exceed the STLC (Appendix B). In SB-021, concentrations of barium, copper, lead, thallium, vanadium and zinc exceed the STLC. In soil boring SB-043, concentrations of barium, copper, lead, nickel, thallium, and vanadium exceed the STLC. Semi-volatile organic contamination is present down to a depth of 35 feet. Volatile organic contamination is also present down to a depth of 35 feet and includes 2-butanone, methylene chloride and toluene. Many of the contaminants in Area 1 are concentrated between the surface and 20 feet below the surface. This includes most of the metals, pesticides and semi-volatile organics.

TABLE 4-10  
CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN AREA 1

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
● Metals				(ppm)	(ppm)	(ppm)
Arsenic	28	28	100	1.08	20.70	7.22
Cadmium	21	21	75	0.19	50.10	4.05
Chromium	28	28	100	4.63	44.10	22.16
Copper	28	28	100	4.14	507.00	41.33
Lead	28	28	100	2.56	75.60	10.59
Mercury	25	25	89	0.02	0.63	0.10
Selenium	21	21	75	0.18	0.52	0.26
● Volatile Organics				(ppb)	(ppb)	(ppb)
2-Butanone	80	27	34	3.00	100.00	26.10
Acetone	53	8	15	11.00	150.00	70.00
Benzene	64	0	0	N/A	N/A	N/A
Chloroform	64	5	8	1.00	3.00	1.60
Ethylbenzene	63	0	0	N/A	N/A	N/A
Methylene Chloride	59	15	25	2.00	13.00	7.90
Toluene	77	36	47	1.00	2300.00	112.90
Xylene (total)	64	1	2	24.00	24.00	24.00
● Pesticides and PCB's				(ppb)	(ppb)	(ppb)
4,4'-DDD	79	6	8	3.00	36.00	15.40
4,4'-DDE	79	6	8	0.80	13.00	6.50
4,4'-DDT	75	1	1	36.00	36.00	36.00
Aldrin	63	0	0	N/A	N/A	N/A
Aroclor-1016	63	0	0	N/A	N/A	N/A
Aroclor-1221	63	0	0	N/A	N/A	N/A
Aroclor-1232	63	0	0	N/A	N/A	N/A
Aroclor-1242	63	0	0	N/A	N/A	N/A
Aroclor-1248	63	0	0	N/A	N/A	N/A
Aroclor-1254	63	0	0	N/A	N/A	N/A
Aroclor-1260	63	0	0	N/A	N/A	N/A
Dieldrin	63	0	0	N/A	N/A	N/A
Heptachlor	63	2	3	2.00	3.00	2.50
Heptachlor epoxide	63	0	0	N/A	N/A	N/A
Toxaphene	63	0	0	N/A	N/A	N/A
alpha-BHC	63	0	0	N/A	N/A	N/A
alpha-Chlordane	63	1	2	300.00	300.00	300.00
beta-BHC	63	0	0	N/A	N/A	N/A
delta-BHC	63	0	0	N/A	N/A	N/A
gamma-BHC (Lindane)	63	2	3	7.00	15.00	11.00
gamma-Chlordane	79	6	8	1.00	450.00	77.00
● Semi-Volatiles Organics				(ppb)	(ppb)	(ppb)
Acenaphthene	64	0	0	N/A	N/A	N/A
Acenaphthylene	62	0	0	N/A	N/A	N/A
Anthracene	64	2	3	1,000.00	1,600.00	1,300.00
Benzo(a)anthracene	80	3	4	76.00	530.00	302.00
Benzo(a)pyrene	80	3	4	55.00	750.00	428.30
Benzo(b)fluoranthene	80	0	0	N/A	N/A	N/A
Benzo(g,h,i)perylene	64	1	2	51.00	51.00	51.00
Benzo(k)fluoranthene	64	0	0	N/A	N/A	N/A
Benzoic Acid	64	2	3	89.00	1,300.00	694.50
Chrysene	80	7	9	88.00	620.00	306.80
Di-n-butylphthalate	67	4	6	77.00	570.00	399.30
Di-n-octylphthalate	80	5	6	31.00	210.00	108.60
Dibenz(a,h)anthracene	64	2	3	16.00	42.00	29.00
Fluoranthene	80	2	3	96.00	260.00	178.00
Fluorene	64	4	6	190.00	260.00	235.00
Indeno(1,2,3-cd)pyrene	64	1	2	58.00	58.00	58.00
Naphthalene	64	3	5	240.00	440.00	333.30
Pentachlorophenol	64	1	2	220.00	220.00	220.00
Phenanthrene	64	4	6	810.00	1,700.00	1,117.50
Pyrene	80	4	5	59.00	260.00	154.80
bis(2-ethylhexyl)phthalate	66	8	12	68.00	5,800.00	917.30

Area 2 - Table 4-11 summarizes the results of the chemical analyses of compounds of concern performed on soil samples collected from this area. Overall, seven (7) metals, seven (7) volatile organics, nineteen (19) semi-volatile organics and nine (9) pesticides/PCB's that have health risk importance were detected in the soil samples. Metals had the highest detection frequencies ranging from 49 to 100 percent. Arsenic, cadmium, copper and lead showed average concentrations greater than or equal to the STLC. Volatile organics of concern were detected in 9 to 62 percent of the samples collected with toluene being the most frequently detected compound. Naphthalene, phenanthrene and Di-n-butylphthalate were the only semi-volatile organics of concern found in more than 10 percent of the samples analyzed. Pesticides/PCBs of concern showed very low detection frequencies (<9%) and they do not appear to present a contamination problem in this area.

A review of the complete set of chemical data from Area 2 in Appendix B indicates that elevated concentrations of metals are present in each section of Area 2. Arsenic, barium, beryllium, cadmium, copper, lead, mercury, nickel, thallium, vanadium and zinc were detected with concentrations exceeding the STLC. 2-Methylnaphthalene, di-n-butylphthalate, naphthalene, pyrene, and phenanthrene are the most common semi-volatile organics present. 2-butanone, acetone, ethylbenzene, methylene chloride, toluene and xylene are the most common volatile organics present. Volatile and semi-volatile organic compound concentrations were the highest in this area of any area evaluated.

In the northwest corner of Area 2, samples from borings SB-024 and SB-025 contained high levels of naphthalene, phenanthrene, benzene, 1,1,1-trichloroethane, toluene and xylene. Soil samples from boring SB-023 in this same area also had high levels of toluene and xylene. The highest concentrations of contaminants in Area 2 were detected between the ground surface and the 20-foot depth. In the southeast corner of Area 2, in soil samples from borings SB-68 and SB-069, elevated concentrations of 1,4-dichlorobenzene, naphthalene, ethylbenzene, toluene and xylene were found. Also in this area, constituents of reservoir waste were found in the soil in varying concentrations down to 35 feet below ground surface. The soil in the northeast corner of Area 2 also contains high levels of naphthalene, phenanthrene, ethylbenzene, toluene and xylene.

TABLE 4-11  
CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN AREA 2

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
● Metals				(ppm)	(ppm)	(ppm)
Arsenic	65	65	100	1.17	68.70	8.96
Cadmium	65	42	65	0.21	3.30	1.00
Chromium	65	65	100	5.20	75.70	24.22
Copper	65	64	98	3.44	243.00	35.08
Lead	65	65	100	1.60	1,140.00	95.93
Mercury	65	49	75	0.02	2.00	0.18
Selenium	61	30	49	0.18	1.10	0.36
● Volatile Organics				(ppb)	(ppb)	(ppb)
2-Butanone	79	20	25	2.00	11,000.00	585.00
Acetone	61	16	26	3.00	780.00	178.20
Benzene	93	8	9	0.20	4,200.00	1,152.90
Chloroform	74	0	0	N/A	N/A	N/A
Ethylbenzene	91	15	16	2.00	240,000.00	4,673.70
Methylene Chloride	58	16	28	1.00	430.00	73.00
Toluene	87	54	62	0.30	39,000.00	1,721.20
Xylene (total)	92	11	12	2.00	140,000.00	25,285.00
● Pesticides and PCB's				(ppb)	(ppb)	(ppb)
4,4'-DDD	83	2	2	62.00	90.00	76.00
4,4'-DDE	88	2	2	31.00	73.00	52.00
4,4'-DDT	80	6	8	4.00	160.00	44.30
Aldrin	88	1	1	23.00	23.00	23.00
Aroclor-1016	73	0	0	N/A	N/A	N/A
Aroclor-1221	73	0	0	N/A	N/A	N/A
Aroclor-1232	73	0	0	N/A	N/A	N/A
Aroclor-1242	73	0	0	N/A	N/A	N/A
Aroclor-1248	77	3	4	72.00	23,000.00	14,024.00
Aroclor-1254	73	3	4	31.00	140.00	97.00
Aroclor-1260	76	2	3	140.00	530.00	335.00
Dieldrin	74	0	0	N/A	N/A	N/A
Heptachlor	74	0	0	N/A	N/A	N/A
Heptachlor epoxide	74	0	0	N/A	N/A	N/A
Toxaphene	76	0	0	N/A	N/A	N/A
alpha-BHC	74	0	0	N/A	N/A	N/A
alpha-Chlordane	74	3	4	1.30	11.00	5.90
beta-BHC	74	0	0	N/A	N/A	N/A
delta-BHC	74	0	0	N/A	N/A	N/A
gamma-BHC (Lindane)	74	0	0	N/A	N/A	N/A
gamma-Chlordane	75	2	3	0.10	6.00	3.10
● Semi-Volatiles Organics				(ppb)	(ppb)	(ppb)
Acenaphthene	78	1	1	83.00	83.00	83.00
Acenaphthylene	77	2	3	20.00	84.00	52.00
Anthracene	86	2	2	53.00	1,100.00	576.50
Benzo(a)anthracene	92	4	4	360.00	1,100.00	590.00
Benzo(a)pyrene	92	3	3	290.00	1,500.00	756.70
Benzo(b)fluoranthene	89	3	3	350.00	2,200.00	1,040.00
Benzo(g,h,i)perylene	83	3	4	110.00	660.00	333.30
Benzo(k)fluoranthene	75	0	0	N/A	N/A	N/A
Benzoic Acid	75	3	4	83.00	230.00	137.70
Chrysene	92	8	9	2.30	2,600.00	718.50
Di-n-butylphthalate	79	12	15	44.00	8,600.00	1,278.70
Di-n-octylphthalate	76	1	1	36.00	36.00	36.00
Dibenz(a,h)anthracene	75	0	0	N/A	N/A	N/A
Fluoranthene	95	5	5	2.10	1,500.00	578.40
Fluorene	86	9	10	2.60	13,000.00	2,732.00
Indeno(1,2,3-cd)pyrene	83	2	2	200.00	450.00	325.00
Naphthalene	94	20	21	7.90	42,000.00	5,798.60
Pentachlorophenol	75	3	4	180.00	320.00	263.30
Phenanthrene	94	23	24	5.00	25,000.00	3,230.10
Pyrene	95	9	9	2.50	4,300.00	1,105.20
bis(2-ethylhexyl)phthalate	79	7	9	91.00	1,600.00	533.00

Area 3 - Table 4-12 is a summary of chemical analyses of compounds of concern conducted on soil samples from two borings in this area. In general, seven (7) metals, four (4) volatile organics, and eight (8) semi-volatile organics were detected in the soil samples. No pesticide/PCB compounds were detected in these samples. Metals concentrations were below STLC levels. The volatile organics found in the soil samples include 2-butanone, toluene, acetone and chloroform. The most frequently detected semi-volatile organic in the samples is di-n-butylphthalate which is also a common laboratory contaminant.

Samples from SB-013, located near the northern edge of Area 3, contained only three volatiles and only two semi-volatiles. No concentrations of these compounds exceed 0.2 parts per million (Appendix B). The metal concentrations in this boring are all close to background levels. Samples from SB-028 were found to contain 4 volatiles, and 7 semivolatiles. The metal concentrations were similar to background levels. The presence of more contaminants in SB-028 relative to SB-013 is apparently because SB-028 is located between 2 separate containment areas and is therefore closer to more contamination.

Area 4 - Table 4-13 includes the summary of chemical concentrations of compounds that are of health risk concern. Overall, seven (7) metals, seven (7) volatile organics, eighteen (18) semi-volatile organics and two (2) pesticides were found in the soil samples from this area. Among metals of concern, arsenic, cadmium, copper, mercury and lead showed concentrations above the STLC. The metals have detection frequencies between 43 to 100 percent. Volatile organics were found in 12 to 78 percent of samples. The highest concentrations of volatiles were associated with toluene (11,000 ppm), ethylbenzene (14,000 ppm) and xylene (42,000 ppm). The detection frequencies of semi-volatiles and pesticides were less than 20 percent and less than 5 percent, respectively indicating these compounds are not of major concern in this area.

TABLE 4-12

CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN AREA 3

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
● Metals				(ppm)	(ppm)	(ppm)
Arsenic	4	4	100	1.89	2.89	2.34
Cadmium	4	4	100	0.25	0.83	0.45
Chromium	4	4	100	6.42	17.70	13.28
Copper	4	4	100	5.82	17.00	11.54
Lead	4	4	100	2.34	15.60	7.15
Mercury	4	4	100	0.02	0.06	0.04
Selenium	4	4	100	0.21	0.24	0.23
● Volatile Organics				(ppb)	(ppb)	(ppb)
2-Butanone	7	6	86	9.00	100.00	54.00
Acetone	7	3	43	33.00	240.00	105.30
Benzene	7	0	0	N/A	N/A	N/A
Chloroform	3	1	33	2.00	2.00	2.00
Ethylbenzene	7	0	0	N/A	N/A	N/A
Methylene Chloride	5	0	0	N/A	N/A	N/A
Toluene	7	3	43	62.00	150.00	114.00
Xylene (total)	7	0	0	N/A	N/A	N/A
● Pesticides and PCB's				(ppb)	(ppb)	(ppb)
4,4'-DDD	3	0	0	N/A	N/A	N/A
4,4'-DDE	7	0	0	N/A	N/A	N/A
4,4'-DDT	7	0	0	N/A	N/A	N/A
Aldrin	3	0	0	N/A	N/A	N/A
Aroclor-1016	3	0	0	N/A	N/A	N/A
Aroclor-1221	3	0	0	N/A	N/A	N/A
Aroclor-1232	3	0	0	N/A	N/A	N/A
Aroclor-1242	3	0	0	N/A	N/A	N/A
Aroclor-1248	3	0	0	N/A	N/A	N/A
Aroclor-1254	3	0	0	N/A	N/A	N/A
Aroclor-1260	3	0	0	N/A	N/A	N/A
Dieldrin	3	0	0	N/A	N/A	N/A
Heptachlor	3	0	0	N/A	N/A	N/A
Heptachlor epoxide	3	0	0	N/A	N/A	N/A
Toxaphene	3	0	0	N/A	N/A	N/A
alpha-BHC	3	0	0	N/A	N/A	N/A
alpha-Chlordane	3	0	0	N/A	N/A	N/A
beta-BHC	3	0	0	N/A	N/A	N/A
delta-BHC	3	0	0	N/A	N/A	N/A
gamma-BHC (Lindane)	3	0	0	N/A	N/A	N/A
gamma-Chlordane	3	0	0	N/A	N/A	N/A
● Semi-Volatiles Organics				(ppb)	(ppb)	(ppb)
Acenaphthene	3	0	0	N/A	N/A	N/A
Acenaphthylene	3	0	0	N/A	N/A	N/A
Anthracene	3	0	0	N/A	N/A	N/A
Benzo(a)anthracene	7	1	14	180.00	180.00	180.00
Benzo(a)pyrene	7	1	14	210.00	210.00	210.00
Benzo(b)fluoranthene	7	1	14	340.00	340.00	340.00
Benzo(g,h,i)perylene	3	0	0	N/A	N/A	N/A
Benzo(k)fluoranthene	3	0	0	N/A	N/A	N/A
Benzoic Acid	3	0	0	N/A	N/A	N/A
Chrysene	7	1	14	200.00	200.00	200.00
Di-n-butylphthalate	6	4	67	98.00	200.00	162.00
Di-n-octylphthalate	3	0	0	N/A	N/A	N/A
Dibenz(a,h)anthracene	3	0	0	N/A	N/A	N/A
Fluoranthene	7	1	14	170.00	170.00	170.00
Fluorene	7	0	0	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	3	0	0	N/A	N/A	N/A
Naphthalene	7	0	0	N/A	N/A	N/A
Pentachlorophenol	3	0	0	N/A	N/A	N/A
Phenanthrene	7	0	0	N/A	N/A	N/A
Pyrene	7	1	14	280.00	280.00	280.00
bis(2-ethylhexyl)phthalate	7	2	29	36.00	66.00	51.00



TABLE 4-13

CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN AREA 4

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
				(ppm)	(ppm)	(ppm)
● Metals						
Arsenic	14	14	100	1.62	12.80	5.23
Cadmium	14	9	64	0.24	1.70	0.56
Chromium	14	14	100	6.59	35.40	22.78
Copper	14	14	100	6.26	48.00	28.45
Lead	14	14	100	3.14	26.80	11.30
Mercury	14	13	93	0.03	0.35	0.15
Selenium	14	6	43	0.24	0.61	0.33
				(ppb)	(ppb)	(ppb)
● Volatile Organics						
2-Butanone	26	3	12	1.00	12.00	6.00
Acetone	11	6	55	12.00	300.00	143.70
Benzene	26	4	15	130.00	6,700.00	3,497.50
Chloroform	24	0	0	N/A	N/A	N/A
Ethylbenzene	26	7	27	4.00	14,000.00	4,760.60
Methylene Chloride	9	7	78	6.00	2,400.00	578.00
Toluene	26	10	38	2.00	11,000.00	1,391.30
Xylene (total)	26	4	15	2.00	42,000.00	11,001.00
				(ppb)	(ppb)	(ppb)
● Pesticides and PCB's						
4,4'-DDD	27	0	0	N/A	N/A	N/A
4,4'-DDE	27	0	0	N/A	N/A	N/A
4,4'-DDT	27	0	0	N/A	N/A	N/A
Aldrin	27	0	0	N/A	N/A	N/A
Aroclor-1016	27	0	0	N/A	N/A	N/A
Aroclor-1221	27	0	0	N/A	N/A	N/A
Aroclor-1232	27	0	0	N/A	N/A	N/A
Aroclor-1242	27	0	0	N/A	N/A	N/A
Aroclor-1248	27	0	0	N/A	N/A	N/A
Aroclor-1254	27	0	0	N/A	N/A	N/A
Aroclor-1260	27	0	0	N/A	N/A	N/A
Dieldrin	27	1	4	35.00	35.00	35.00
Heptachlor	27	1	4	87.00	87.00	87.00
Heptachlor epoxide	27	0	0	N/A	N/A	N/A
Toxaphene	27	0	0	N/A	N/A	N/A
alpha-BHC	27	0	0	N/A	N/A	N/A
alpha-Chlordane	27	0	0	N/A	N/A	N/A
beta-BHC	27	0	0	N/A	N/A	N/A
delta-BHC	27	0	0	N/A	N/A	N/A
gamma-BHC (Lindane)	27	0	0	N/A	N/A	N/A
gamma-Chlordane	27	0	0	N/A	N/A	N/A
				(ppb)	(ppb)	(ppb)
● Semi-Volatiles Organics						
Acenaphthene	27	3	11	140.00	2,300.00	1,546.70
Acenaphthylene	27	0	0	N/A	N/A	N/A
Anthracene	27	1	4	16,000.00	16,000.00	16,000.00
Benzo(a)anthracene	27	1	4	1,500.00	1,500.00	1,500.00
Benzo(a)pyrene	27	1	4	110.00	110.00	110.00
Benzo(b)fluoranthene	27	1	4	170.00	170.00	170.00
Benzo(g,h,i)perylene	27	1	4	77.00	77.00	77.00
Benzo(k)fluoranthene	27	1	4	91.00	91.00	91.00
Benzoic Acid	27	2	7	76.00	87.00	81.50
Chrysene	27	5	19	97.00	8,000.00	2,201.40
Di-n-butylphthalate	23	1	4	470.00	470.00	470.00
Di-n-octylphthalate	27	2	7	110.00	120.00	115.00
Dibenz(a,h)anthracene	27	0	0	N/A	N/A	N/A
Fluoranthene	27	1	4	68.00	68.00	68.00
Fluorene	27	5	19	1,100.00	18,000.00	7,840.00
Indeno(1,2,3-cd)pyrene	27	1	4	74.00	74.00	74.00
Naphthalene	27	5	19	660.00	24,000.00	13,032.00
Pentachlorophenol	27	0	0	N/A	N/A	N/A
Phenanthrene	27	4	15	430.00	29,000.00	10,632.50
Pyrene	27	4	15	47.00	1,500.00	425.30
bis(2-ethylhexyl)phthalate	18	3	17	65.00	190.00	107.00

A review of the complete data set on soil samples collected from this area indicates that the concentrations of arsenic, barium, beryllium, copper, lead, mercury, nickel, thallium, vanadium and zinc exceed STLC levels. Dieldrin, endrin, and heptachlor are the only pesticides present. Naphthalene, 2-Methylnaphthalene, fluorene and chrysene are the most prevalent semivolatiles and methylene chloride, toluene, ethylbenzene and acetone are the most common volatiles. The majority of contaminants in this area were found between the surface and 25 feet below ground surface. Semi-volatile and volatile organic contaminants were found mostly in the black sump material in this area and in the sediments directly beneath this material.

Area 5 - Table 4-14 is a summary of chemical analyses results that are of health risk concern. Seven (7) metals, four (4) volatile organics, three (3) semi-volatile organics and one pesticide compound were detected in the soil samples. Metals concentrations were detected in more than 67 percent of the samples. Among metals on concern, arsenic, cadmium, copper, lead, mercury and selenium were found in concentrations greater than the STLC. 2-butanone, acetone, chloroform and toluene were the only volatile organics detected in 10 to 40 percent of the samples. The last three compounds are common laboratory contaminants. Di-n-butylphthalate, pyrene, and bis(2-ethylhexyl)phthalate were the only semi-volatiles found in less than four samples.

Based on the complete chemical data on soil samples collected from this area, arsenic, cadmium, chromium, thallium, mercury, cobalt, copper, lead, and selenium were detected at depths of 10 and 35 feet. One pesticide (alpha-BHC), eight semi-volatiles and two volatiles were also detected.

Area 6 - Table 4-15 includes summary results on chemical compounds that are of health risk concern. Overall, seven (7) metals, seven (7) volatile organics, seven (7) semi-volatile organics and one PCB were found in the soil samples. Arsenic, cadmium, copper and lead were found in concentrations greater than the STLC levels. Among volatile organics, 2-butanone, benzene, ethylbenzene, xylene, acetone, methylene chloride and toluene were detected.

TABLE 4-14  
CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN AREA 5

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
● Metals				(ppm)	(ppm)	(ppm)
Arsenic	5	5	100	7.50	17.00	11.70
Cadmium	6	4	67	0.27	1.40	0.85
Chromium	6	6	100	6.70	43.20	30.57
Copper	6	6	100	22.50	103.00	62.93
Lead	6	6	100	1.70	19.50	9.30
Mercury	6	5	83	0.04	0.32	0.15
Selenium	5	4	80	0.26	4.80	1.47
● Volatile Organics				(ppb)	(ppb)	(ppb)
2-Butanone	10	2	20	12.00	15.00	13.50
Acetone	5	2	40	7.00	28.00	17.50
Benzene	10	0	0	N/A	N/A	N/A
Chloroform	10	1	10	5.00	5.00	5.00
Ethylbenzene	10	0	0	N/A	N/A	N/A
Methylene Chloride	2	0	0	N/A	N/A	N/A
Toluene	10	4	40	1.00	420.00	123.00
Xylene (total)	10	0	0	N/A	N/A	N/A
● Pesticides and PCB's				(ppb)	(ppb)	(ppb)
4,4'-DDD	10	0	0	N/A	N/A	N/A
4,4'-DDE	10	0	0	N/A	N/A	N/A
4,4'-DDT	10	1	10	22.00	22.00	22.00
Aldrin	10	0	0	N/A	N/A	N/A
Aroclor-1016	10	0	0	N/A	N/A	N/A
Aroclor-1221	10	0	0	N/A	N/A	N/A
Aroclor-1232	10	0	0	N/A	N/A	N/A
Aroclor-1242	10	0	0	N/A	N/A	N/A
Aroclor-1248	10	0	0	N/A	N/A	N/A
Aroclor-1254	10	0	0	N/A	N/A	N/A
Aroclor-1260	10	0	0	N/A	N/A	N/A
Dieldrin	10	0	0	N/A	N/A	N/A
Heptachlor	10	0	0	N/A	N/A	N/A
Heptachlor epoxide	10	0	0	N/A	N/A	N/A
Toxaphene	10	0	0	N/A	N/A	N/A
alpha-BHC	10	0	0	N/A	N/A	N/A
alpha-Chlordane	10	0	0	N/A	N/A	N/A
beta-BHC	10	0	0	N/A	N/A	N/A
delta-BHC	10	0	0	N/A	N/A	N/A
gamma-BHC (Lindane)	10	0	0	N/A	N/A	N/A
gamma-Chlordane	10	0	0	N/A	N/A	N/A
● Semi-Volatiles Organics				(ppb)	(ppb)	(ppb)
Acenaphthene	10	0	0	N/A	N/A	N/A
Acenaphthylene	10	0	0	N/A	N/A	N/A
Anthracene	10	0	0	N/A	N/A	N/A
Benzo(a)anthracene	10	0	0	N/A	N/A	N/A
Benzo(a)pyrene	10	0	0	N/A	N/A	N/A
Benzo(b)fluoranthene	10	0	0	N/A	N/A	N/A
Benzo(g,h,i)perylene	10	0	0	N/A	N/A	N/A
Benzo(k)fluoranthene	10	0	0	N/A	N/A	N/A
Benzoic Acid	10	0	0	N/A	N/A	N/A
Chrysene	10	0	0	N/A	N/A	N/A
Di-n-butylphthalate	23	3	30	90.00	860.00	513.30
Di-n-octylphthalate	10	0	0	N/A	N/A	N/A
Dibenz(a,h)anthracene	10	0	0	N/A	N/A	N/A
Fluoranthene	10	0	0	N/A	N/A	N/A
Fluorene	10	0	0	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	10	0	0	N/A	N/A	N/A
Naphthalene	10	0	0	N/A	N/A	N/A
Pentachlorophenol	10	0	0	N/A	N/A	N/A
Phenanthrene	10	0	0	N/A	N/A	N/A
Pyrene	10	1	10	87.00	87.00	87.00
bis(2-ethylhexyl)phthalate	10	2	20	140.00	150.000	145.00

TABLE 4-15  
CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN AREA 6

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
				(ppm)	(ppm)	(ppm)
● Metals						
Arsenic	5	5	100	3.50	9.55	6.05
Cadmium	6	6	100	0.30	2.30	1.40
Chromium	6	5	83	7.40	30.00	17.48
Copper	6	6	100	6.00	39.20	17.06
Lead	6	6	100	1.50	13.50	6.27
Mercury	6	3	50	0.03	0.11	0.08
Selenium	6	2	33	0.25	0.26	0.26
				(ppb)	(ppb)	(ppb)
● Volatile Organics						
2-Butanone	17	2	12	20.00	92.00	56.00
Acetone	5	5	100	29.00	73.00	42.40
Benzene	17	2	12	1.00	6.00	3.50
Chloroform	14	0	0	N/A	N/A	N/A
Ethylbenzene	17	3	18	5.00	11.00	8.70
Methylene Chloride	4	4	100	6.00	8.00	7.25
Toluene	17	4	24	2.00	24.00	13.50
Xylene (total)	17	3	18	16.00	31.00	24.30
				(ppb)	(ppb)	(ppb)
● Pesticides and PCB's						
4,4'-DDD	17	0	0	N/A	N/A	N/A
4,4'-DDE	17	0	0	N/A	N/A	N/A
4,4'-DDT	17	0	0	N/A	N/A	N/A
Aldrin	17	0	0	N/A	N/A	N/A
Aroclor-1016	17	0	0	N/A	N/A	N/A
Aroclor-1221	17	0	0	N/A	N/A	N/A
Aroclor-1232	17	0	0	N/A	N/A	N/A
Aroclor-1242	17	0	0	N/A	N/A	N/A
Aroclor-1248	17	1	6	1,700.00	1,700.000	1,700.00
Aroclor-1254	17	0	0	N/A	N/A	N/A
Aroclor-1260	17	0	0	N/A	N/A	N/A
Dieldrin	17	0	0	N/A	N/A	N/A
Heptachlor	17	0	0	N/A	N/A	N/A
Heptachlor epoxide	17	0	0	N/A	N/A	N/A
Toxaphene	17	0	0	N/A	N/A	N/A
alpha-BHC	17	0	0	N/A	N/A	N/A
alpha-Chlordane	17	0	0	N/A	N/A	N/A
beta-BHC	17	0	0	N/A	N/A	N/A
delta-BHC	17	0	0	N/A	N/A	N/A
gamma-BHC (Lindane)	17	0	0	N/A	N/A	N/A
gamma-Chlordane	17	0	0	N/A	N/A	N/A
				(ppb)	(ppb)	(ppb)
● Semi-Volatiles Organics						
Acenaphthene	17	0	0	N/A	N/A	N/A
Acenaphthylene	17	1	6	71.00	71.00	71.00
Anthracene	17	0	0	N/A	N/A	N/A
Benzo(a)anthracene	17	0	0	N/A	N/A	N/A
Benzo(a)pyrene	17	0	0	N/A	N/A	N/A
Benzo(b)fluoranthene	17	1	6	N/A	N/A	N/A
Benzo(g,h,i)perylene	17	0	0	N/A	N/A	N/A
Benzo(k)fluoranthene	17	0	0	N/A	N/A	N/A
Benzoic Acid	17	2	12	69.00	220.00	144.50
Chrysene	17	0	0	N/A	N/A	N/A
Di-n-butylphthalate	17	1	6	1,800.00	1,800.00	1,800.00
Di-n-octylphthalate	17	1	6	88,000.00	88,000.00	88,000.00
Dibenz(a,h)anthracene	17	0	0	N/A	N/A	N/A
Fluoranthene	17	1	6	150.00	150.00	150.00
Fluorene	17	0	0	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	17	0	0	N/A	N/A	N/A
Naphthalene	17	0	0	N/A	N/A	N/A
Pentachlorophenol	17	0	0	N/A	N/A	N/A
Phenanthrene	17	0	0	N/A	N/A	N/A
Pyrene	17	1	6	220.00	220.00	220.00
bis(2-ethylhexyl)phthalate	14	4	29	38.00	830,000.00	209,584.00

Benzene, ethylbenzene and xylene are constituents commonly found in petroleum hydrocarbons. Bis(2-ethylhexyl)phthalate and benzoic acid were the only semi-volatile organic compounds detected in more than one sample.

The concentrations of organics compounds found in this area are not as high as those found in other areas (Appendix B). This suggests that Area 6 may have had limited use. However, an aerial photo taken in 1937 (Figure 1-3) shows some dark standing liquid in the northwest corner of the area, just west of SB-061.

Area 7 - Table 4-16 presents a summary of chemical analyses results on compounds of health risk concern. Overall, seven (7) metals, three (3) volatile organics, four (4) semi-volatile organics and no pesticides/PCB's were detected in the soil samples. Among metals, arsenic, cadmium, copper and lead showed concentrations above the STLC levels. Acetone, ethylbenzene and methylene chloride were the volatile organic compounds found in the samples. Pyrene, benzo(a)pyrene, chrysene and and bis(2-ethylhexyl)s were the semi-volatile organics found in only one soil sample.

Based on the complete chemical data set (Appendix B), the majority of metals are present in samples from the 0-foot and 5-foot depths. Lead, barium, beryllium, cadmium, copper, nickel, thallium, vanadium and zinc exceed the STLC levels. The semi-volatile benzo(a)pyrene is present at the 5-foot depth with a concentration of .96 ppm.

The presence of high concentrations of barium in this area is not surprising since this area was apparently used to dispose of oil field drilling muds. Several manufacturing activities and chemical spills have also been documented in this area. The apparent absence of contamination below the 20-foot depth implies that vertical downward migration of contaminants may not have occurred in this area.

Area 8 - Table 4-17 is a summary of chemical analyses results on compounds of health risk concern in this area. In general, seven (7) metals, six (6)

TABLE 4-16

CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN AREA 7

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
● Metals				(ppm)	(ppm)	(ppm)
Arsenic	3	3	100	3.00	12.10	6.50
Cadmium	4	3	75	1.64	5.70	3.21
Chromium	4	4	100	20.20	55.80	35.58
Copper	4	4	100	19.80	79.70	49.30
Lead	4	4	100	10.00	63.00	29.25
Mercury	4	1	25	0.02	0.02	0.02
Selenium	2	1	50	0.25	0.25	0.25
● Volatile Organics				(ppb)	(ppb)	(ppb)
2-Butanone	5	0	0	N/A	N/A	N/A
Acetone	2	1	50	16.00	16.00	16.00
Benzene	4	0	0	N/A	N/A	N/A
Chloroform	4	0	0	N/A	N/A	N/A
Ethylbenzene	4	1	25	3.00	3.00	3.00
Methylene Chloride	3	2	67	4.00	810.00	407.00
Toluene	3	0	0	N/A	N/A	N/A
Xylene (total)	3	0	0	N/A	N/A	N/A
● Pesticides and PCB's				(ppb)	(ppb)	(ppb)
4,4'-DDD	6	0	0	N/A	N/A	N/A
4,4'-DDE	6	0	0	N/A	N/A	N/A
4,4'-DDT	6	0	0	N/A	N/A	N/A
Aldrin	6	0	0	N/A	N/A	N/A
Aroclor-1016	6	0	0	N/A	N/A	N/A
Aroclor-1221	6	0	0	N/A	N/A	N/A
Aroclor-1232	6	0	0	N/A	N/A	N/A
Aroclor-1242	6	0	0	N/A	N/A	N/A
Aroclor-1248	6	0	0	N/A	N/A	N/A
Aroclor-1254	6	0	0	N/A	N/A	N/A
Aroclor-1260	6	0	0	N/A	N/A	N/A
Dieldrin	6	0	0	N/A	N/A	N/A
Heptachlor	6	0	0	N/A	N/A	N/A
Heptachlor epoxide	6	0	0	N/A	N/A	N/A
Toxaphene	6	0	0	N/A	N/A	N/A
alpha-BHC	6	0	0	N/A	N/A	N/A
alpha-Chlordane	6	0	0	N/A	N/A	N/A
beta-BHC	6	0	0	N/A	N/A	N/A
delta-BHC	6	0	0	N/A	N/A	N/A
gamma-BHC (Lindane)	6	0	0	N/A	N/A	N/A
gamma-Chlordane	6	0	0	N/A	N/A	N/A
● Semi-Volatiles Organics				(ppb)	(ppb)	(ppb)
Acenaphthene	6	0	0	N/A	N/A	N/A
Acenaphthylene	6	0	0	N/A	N/A	N/A
Anthracene	6	0	0	N/A	N/A	N/A
Benzo(a)anthracene	6	0	0	N/A	N/A	N/A
Benzo(a)pyrene	6	1	17	960.00	960.00	960.00
Benzo(b)fluoranthene	6	0	0	N/A	N/A	N/A
Benzo(g,h,i)perylene	6	0	0	N/A	N/A	N/A
Benzo(k)fluoranthene	6	0	0	N/A	N/A	N/A
Benzoic Acid	5	0	0	N/A	N/A	N/A
Chrysene	6	1	17	300.00	300.00	300.00
Di-n-butylphthalate	4	0	0	N/A	N/A	N/A
Di-n-octylphthalate	6	0	0	N/A	N/A	N/A
Dibenz(a,h)anthracene	6	0	0	N/A	N/A	N/A
Fluoranthene	6	0	0	N/A	N/A	N/A
Fluorene	6	0	0	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	6	0	0	N/A	N/A	N/A
Naphthalene	6	0	0	N/A	N/A	N/A
Pentachlorophenol	6	0	0	N/A	N/A	N/A
Phenanthrene	6	0	0	N/A	N/A	N/A
Pyrene	6	1	17	36.00	36.00	36.00
bis(2-ethylhexyl)phthalate	4	1	25	25.00	350.00	350.00

TABLE 4-17

CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN AREA 8

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
				(ppm)	(ppm)	(ppm)
● Metals						
Arsenic	52	52	100	1.00	18.00	6.04
Cadmium	52	20	38	0.33	1.87	0.98
Chromium	52	52	100	5.70	62.70	21.87
Copper	52	51	98	4.80	270.00	28.09
Lead	52	52	100	1.50	2,640.00	71.38
Mercury	52	30	58	0.02	0.62	0.16
Selenium	51	17	33	0.20	1.20	0.58
				(ppb)	(ppb)	(ppb)
● Volatile Organics						
2-Butanone	22	3	14	11.00	78.00	34.30
Acetone	20	3	15	8.00	63.00	29.00
Benzene	44	0	0	N/A	N/A	N/A
Chloroform	38	0	0	N/A	N/A	N/A
Ethylbenzene	45	8	18	10.00	11,000.00	3,122.90
Methylene Chloride	24	7	29	1.00	14.00	266.90
Toluene	42	30	71	6.00	12,000.00	735.40
Xylene (total)	44	6	14	360.00	2,800.00	1,865.00
				(ppb)	(ppb)	(ppb)
● Pesticides and PCB's						
4,4'-DDD	41	6	15	130.00	62,000.00	11,921.70
4,4'-DDE	41	5	12	66.00	30,000.00	6,261.20
4,4'-DDT	33	3	9	6.00	260,000.00	87,113.30
Aldrin	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1016	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1221	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1232	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1242	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1248	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1254	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1260	0	N/A	N/A	N/A	N/A	N/A
Dieldrin	0	N/A	N/A	N/A	N/A	N/A
Heptachlor	0	N/A	N/A	N/A	N/A	N/A
Heptachlor epoxide	0	N/A	N/A	N/A	N/A	N/A
Toxaphene	0	N/A	N/A	N/A	N/A	N/A
alpha-BHC	0	N/A	N/A	N/A	N/A	N/A
alpha-Chlordane	0	N/A	N/A	N/A	N/A	N/A
beta-BHC	0	N/A	N/A	N/A	N/A	N/A
delta-BHC	36	2	6	230.00	980.00	605.00
gamma-BHC (Lindane)	0	N/A	N/A	N/A	N/A	N/A
gamma-Chlordane	36	5	14	36.00	12.00	483.20
				(ppb)	(ppb)	(ppb)
● Semi-Volatiles Organics						
Acenaphthene	33	0	0	N/A	N/A	N/A
Acenaphthylene	40	0	0	N/A	N/A	N/A
Anthracene	38	1	3	620.00	620.00	620.00
Benzo(a)anthracene	38	0	0	N/A	N/A	N/A
Benzo(a)pyrene	38	1	3	96.00	96.00	96.00
Benzo(b)fluoranthene	38	1	3	130.00	130.00	130.00
Benzo(g,h,i)perylene	36	1	3	91.00	91.00	91.00
Benzo(k)fluoranthene	33	0	0	N/A	N/A	N/A
Benzoic Acid	38	0	0	N/A	N/A	N/A
Chrysene	38	4	11	99.00	280.00	167.30
Di-n-butylphthalate	30	3	10	52.00	190.00	120.70
Di-n-octylphthalate	33	2	6	230.00	240.00	235.00
Dibenz(a,h)anthracene	31	0	0	N/A	N/A	N/A
Fluoranthene	39	0	0	N/A	N/A	N/A
Fluorene	34	5	15	92.00	2,000.00	590.40
Indeno(1,2,3-cd)pyrene	36	1	3	89.00	89.00	89.00
Naphthalene	46	6	13	78.00	1,900.00	804.70
Pentachlorophenol	33	0	0	N/A	N/A	N/A
Phenanthrene	39	6	15	76.00	4,500.00	1,191.00
Pyrene	38	1	3	770.00	770.00	770.00
bis(2-ethylhexyl)phthalate	23	4	17	84.00	490.00	251.00

volatile organics, thirteen (13) semi-volatiles and five (5) pesticides are present in the soil samples. Among metals, arsenic, cadmium, copper, mercury, selenium and lead have concentrations greater than the STLC levels and were detected in almost all samples. Detection frequencies of volatile organics were between 14 and 71 percent. The most frequent volatile organic compound detected was toluene.

Based on the complete set of chemical data (Appendix B), the metals with the highest concentrations were aluminum, calcium and magnesium. The concentrations of arsenic, barium, copper, mercury, lead, nickel, selenium, thallium and vanadium at times all exceed the STLC levels. Soil from boring SB-086 contains primarily one volatile organic, toluene. Small amounts of naphthalene, phenanthrene and toluene are present in the soil from borings SB-076 and SB-085, two borings which showed no visible signs of waste materials.

St. Paul's High School and Fedco - Table 4-18 summarizes the concentrations of chemical compounds of concern in this area. Overall, seven (7) metals, two (2) volatile organics, and no semi-volatiles or pesticides/PCB's were detected at St. Paul's and Fedco. The chemical analyses results from this area are representative of background concentrations. The concentrations of arsenic, copper and lead exceed the STLC levels. The volatile organics detected in this area, acetone and chloroform, are common laboratory contaminants.

#### 4.4 GROUNDWATER QUALITY ANALYSES

This section presents the results of chemical analyses conducted on groundwater samples from the WDI monitoring wells. These results are compared against state and federal drinking water standards. The comparison of chemical data from the upgradient and downgradient wells are used to identify if elevated levels of chemical compounds in groundwater has been caused by migration of contaminants from the WDI waste handling areas.



TABLE 4-18

CHEMICAL CONCENTRATIONS OF COMPOUNDS  
OF CONCERN IN SCHOOL/FEDCO

Analyte	No. of Samples	No. of Detects	Frequency (%) of Detects	Min.	Max.	Average
● Metals				(ppm)	(ppm)	(ppm)
Arsenic	12	12	100	1.63	15.90	5.56
Cadmium	12	3	25	0.26	0.36	0.29
Chromium	12	12	100	5.90	51.20	17.85
Copper	12	12	100	4.95	41.50	20.27
Lead	12	12	100	1.70	10.00	5.92
Mercury	12	6	50	0.02	0.19	0.12
Selenium	12	3	25	0.20	0.28	0.24
● Volatile Organics				(ppb)	(ppb)	(ppb)
2-Butanone	0	N/A	N/A	N/A	N/A	N/A
Acetone	6	3	50	11.00	32.00	24.30
Benzene	0	N/A	N/A	N/A	N/A	N/A
Chloroform	6	2	33	1.00	2.00	1.50
Ethylbenzene	0	N/A	N/A	N/A	N/A	N/A
Methylene Chloride	0	N/A	N/A	N/A	N/A	N/A
Toluene	0	N/A	N/A	N/A	N/A	N/A
Xylene (total)	0	N/A	N/A	N/A	N/A	N/A
● Pesticides and PCB's						
4,4'-DDD	0	N/A	N/A	N/A	N/A	N/A
4,4'-DDE	0	N/A	N/A	N/A	N/A	N/A
4,4'-DDT	0	N/A	N/A	N/A	N/A	N/A
Aldrin	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1016	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1221	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1232	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1242	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1248	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1254	0	N/A	N/A	N/A	N/A	N/A
Aroclor-1260	0	N/A	N/A	N/A	N/A	N/A
Dieldrin	0	N/A	N/A	N/A	N/A	N/A
Heptachlor	0	N/A	N/A	N/A	N/A	N/A
Heptachlor epoxide	0	N/A	N/A	N/A	N/A	N/A
Toxaphene	0	N/A	N/A	N/A	N/A	N/A
alpha-BHC	0	N/A	N/A	N/A	N/A	N/A
alpha-Chlordane	0	N/A	N/A	N/A	N/A	N/A
beta-BHC	0	N/A	N/A	N/A	N/A	N/A
delta-BHC	0	N/A	N/A	N/A	N/A	N/A
gamma-BHC (Lindane)	0	N/A	N/A	N/A	N/A	N/A
gamma-Chlordane	0	N/A	N/A	N/A	N/A	N/A
● Semi-Volatiles Organics						
Acenaphthene	0	N/A	N/A	N/A	N/A	N/A
Acenaphthylene	0	N/A	N/A	N/A	N/A	N/A
Anthracene	0	N/A	N/A	N/A	N/A	N/A
Benzo(a)anthracene	0	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	0	N/A	N/A	N/A	N/A	N/A
Benzo(g,h,i)perylene	0	N/A	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0	N/A	N/A	N/A	N/A	N/A
Benzoic Acid	0	N/A	N/A	N/A	N/A	N/A
Chrysene	0	N/A	N/A	N/A	N/A	N/A
Di-n-butylphthalate	0	N/A	N/A	N/A	N/A	N/A
Di-n-octylphthalate	0	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	0	N/A	N/A	N/A	N/A	N/A
Fluoranthene	0	N/A	N/A	N/A	N/A	N/A
Fluorene	0	N/A	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	0	N/A	N/A	N/A	N/A	N/A
Naphthalene	0	N/A	N/A	N/A	N/A	N/A
Pentachlorophenol	0	N/A	N/A	N/A	N/A	N/A
Phenanthrene	0	N/A	N/A	N/A	N/A	N/A
Pyrene	0	N/A	N/A	N/A	N/A	N/A
bis(2-ethylhexyl)phthalate	0	N/A	N/A	N/A	N/A	N/A

#### 4.4.1 Drinking Water Standards

EPA has promulgated drinking water regulations designed to protect human health from the potential adverse effects of drinking water contaminants. These drinking water regulations generally apply to community water systems, which are public water systems having at least 15 service connections or serving an average of at least 25 year-round residents.\* The drinking water standards and regulations promulgated in July 1987 for eight synthetic organic chemicals (52 FR 25690, July 8, 1987) also apply to a new category of suppliers referred to as non-transient, non-community systems.\*\* These systems are those that regularly serve at least 25 of the same persons over 6 months per year (e.g., rural schools).

#### Use of MCLs/MCLGs/SMCLs

Primary drinking water regulations include MCLs for specific contaminants. MCLs are enforceable standards which apply to specified contaminants which EPA has determined have an adverse effect on human health. MCLs are set at levels that are protective of human health, and are set as close to MCLGs\*\*\* as is feasible taking into account available treatment technologies and the costs to large public water systems. MCLGs, in contrast, are strictly health-based and do not take cost or feasibility into account. As health goals, MCLGs are established at levels at which no known or anticipated adverse effects on the health of persons occur and which allow an adequate margin of safety. To date, MCLs have been promulgated for 30 specific chemicals (10 inorganics, 14 organic chemicals including pesticides, and

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\* Certain drinking water standards also apply to non-community water systems. These include standards for nitrate, turbidity, microbiological concentrations (40 CFR §141.11, 40 CFR §141.13, and 40 CFR §141.14 respectively).

\*\* EPA plans to continue to extend its drinking water regulations to non-transient, non-community systems.

\*\*\* Recommended maximum contaminant levels (RMCLs) were renamed maximum contaminant level goals (MCLGs) by the 1986 Amendments to the Safe Drinking Water Act.

total trihalomethanes, certain radio-nuclides, coliform bacteria and turbidity). The SDWA amendments of 1986 require EPA to promulgate MCLs for 83 specific contaminants (including reproposal of the earlier-promulgated 30 contaminants with the exception of silver and total trihalomethanes) by June 1989. A list of these 83 contaminants and their promulgation schedule is provided in Table 4-19. MCLGs have been published for 8 organic contaminants and for fluoride. A list of current MCLs is presented in Table 4-20.

For water that is to be used for drinking, the MCLs set under the Safe Drinking Water Act are generally the applicable or relevant and appropriate standard. MCLs are applicable where the water will be provided directly to 25 or more people or will be supplied to 15 or more service connections. If MCLs are applicable, they are applied at the tap. In addition, MCLs are relevant and appropriate as in situ cleanup standards where either surface water or ground water is or may be used for drinking water. When no promulgated standard exists for a given contaminant, proposed MCLs are to be given greater consideration among the to-be-considered advisories.

A standard for drinking water more stringent than an MCL may be needed in special circumstances, such as where multiple contaminants in groundwater or multiple pathways of exposure present extraordinary risks (i.e., above an individual lifetime cancer risk of  $10^{-4}$ ). In setting a level more stringent than the MCL in such cases, a site-specific determination should be made by considering MCLGs, the Agency's policy on the use of appropriate risk ranges for carcinogens, levels of quantification, and other pertinent guidelines. Prior consultation with Headquarters contacts in the Office of Emergency and Remedial Response or the Office of Waste Programs Enforcement, as appropriate, is encouraged in such cases.

The responsibility for enforcing primary drinking water regulations resides with the appropriate State government agency in those States where EPA has granted the State primary enforcement authority or with EPA in the two States that do not have primary enforcement (Indiana and Wyoming). Suppliers of water may be assessed criminal or civil penalties for violations of primary drinking water regulations. In addition, suppliers are required to notify the public regarding violations of primary drinking water standards.

TABLE 4-19

LIST OF 83 CONTAMINANTS FOR WHICH MCLs  
MUST BE PROMULGATED BY JUNE 1989

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9 MCLs Currently Final

Benzene	1,2-Dichloroethane	1,1,1-Trichloroethane
Carbon Tetrachloride	1,1-Dichloroethylene	Trichloroethylene
p-Dichlorobenzene	Fluoride	Vinyl Chloride

40 Contaminants Mandated for MCL Promulgation by June 1988 <sup>a</sup>

Acrylamide	o-Dichlorobenzene	*Lindane
Aldicarb	cis-1,2 Dichloro	*Mercury
Alachlor	ethylene	*Methoxychlor
*Arsenic	trans- 1,2 Dichloro-	*Nitrate
Asbestos	ethylene	PCBs
*Barium	*2,4- Dichlorophenosy-	Pentachlorophenol
*Cadmium	acetic Acid (2,4-D)	*Selenium
Carbofuran	1,2 Dichloropropane	*2,4,5- TP Silvex
Chlordane	Epichlorohydrin	Styrene
Chlorobenzene	Ethyl Benzene	Toluene
*Chromium	Ethylene Dibromide	*Toxaphene
*Coliform Bacteria	Giardia Lamblia	*Turbidity
Copper	Heptachlor	Viruses
Dibromochloropropane	Heptachlor Epoxide	Xylene
(DBCP)	*Lead	

34 Contaminants Mandated for MCL Promulgation by June 1989

Adipates	*Endrin	*Radium 226 and 228
Aldicarb Sulfone	Endothall	Radon
Aldicarb Sulfoxide	Glyphosate	Simazine
Antimony	*Gross alpha particle	Standard Plate Count
Atrazine	activity	Sulfate
Berlyllium	Hexochlorocyclopentadiene	2,3,7,8 - TCDD (Dioxin)
*Beta particle - Photon	Legionella	Tetrachloroethylene
Radioactivity	Methylene Chloride	Thallium
Cyanide	Nickel	Trichlorobenzene
Dalapon	PAHs	1,1,2 - Trichloroethane
Dinoseb	Phthalates	Uranium
Diquat	Pichloram	vydate

\* 19 MCLs to be repropoed.

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<sup>a</sup> At the time of this report, no MCLs for these contaminants had been proposed or promulgated under SDWA amendments of 1986.

TABLE 4-20

## CURRENT MAXIMUM CONTAMINANT LEVELS (MCLs)

Contaminant	MCL (in ppb)
Aluminum	1,000
Arsenic	50
Barium	1,000
Chromium	50
Copper	1,000
Iron	300
Lead	50
Manganese	50
Mercury	2
Selenium	10
Silver	50
Zinc	5,000
Toluene	100
Trichloroethene	5

Secondary drinking water regulations consist primarily of Secondary Maximum Contaminant Levels (SMCLs) for specific contaminants or water characteristics that may affect the aesthetic qualities of drinking water (i.e., color, odor, and taste). SMCLs are nonenforceable limits intended as guidelines for use by states in regulating water supplies. SMCLs apply to public water systems and are measured at the tap of the user of the system. A list of existing SMCLs is presented in Table 4-21. For States that have adopted SMCLs as additional drinking water standards, SMCLs are potential State ARARs, depending on site conditions.

#### 4.4.2 Background Chemical Concentrations

Samples of groundwater were collected from GW-01 and GW-02, both wells which are installed upgradient of the WDI reservoir. The analysis of water samples from these wells is reported in Table 4-22. As is seen in this table, aluminum, and selenium were found in both of these wells in concentrations above the Safe Drinking Water Act (SDWA), Primary Maximum Contaminant Level (MCL), standards. The concentrations of iron and manganese in these wells also exceed the Secondary Maximum Contaminant Levels (MCL). Chromium was detected in concentrations above the MCL standard in well GW-01 only. Arsenic, barium, copper, lead and zinc were found in both upgradient wells but at concentrations lower than the MCL standards. Calcium, magnesium, potassium and sodium were also found in both wells. Concentrations of cobalt, nickel, and vanadium were also detected. Volatile organics, semivolatile organics and pesticides/PCB compounds were not detected in these upgradient wells.

Since metal concentrations in the upgradient wells appeared to be very different, GW-01 was resampled on June 13, 1989 to confirm the validity of the data. Both filtered and unfiltered samples were collected and analyzed for metals. The results of chemical analyses on these samples are summarized in Table 4-23. In general, the concentrations of metals detected in the unfiltered samples are slightly higher than that for the filtered samples. This indicates that analysis of unfiltered samples provides more conservative estimates of metal concentrations. For the most part, metals

TABLE 4-21

SECONDARY MAXIMUM CONTAMINANT LEVELS (SMCLs)  
UNDER THE SAFE DRINKING WATER ACT

Contaminant	Level
Chloride	250 mg/l
Color	15 color units
Copper	1 mg/l
Corrosivity	Noncorrosive
Fluoride	2.0 mg/l
Foaming agent	0.5 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Odor	3 threshold odor number
pH	6.5-8.5
Sulfate	250 mg/l
Total dissolved solids	500 mg/l
Zinc	5 mg/l

Source: 40 CFR §143.3.

TABLE 4-22

BACKGROUND CHEMICAL CONCENTRATIONS  
UPGRADIENT GROUNDWATER MONITORING WELLS  
WASTE DISPOSAL INC.

Parameter	<u>GW-01</u>	<u>GW-02</u>
	Value (ug/l)	Value (ug/l)
Aluminum	48,400.00	3,570.00
Antimony	3.60	2.00
Arsenic	25.00	3.40
Barium	907.00	125.000
Beryllium	2.00	2.00
Cadmium	5.00	5.00
Calcium	354,000.00	243,000.00
Chromium	91.30	26.80
Cobalt	49.00	15.00
Copper	127.00	12.40
Iron	79,300.00	6,110.00
Lead	34.00	3.60
Magnesium	114,000.00	66,300.00
Manganese	2,550.00	183.00
Mercury	0.20	0.20
Nickel	79.40	26.70
Potassium	18,400.00	7,250.00
Selenium	80.10	20.40
Silver	7.00	7.00
Sodium	158,000.00	129,000.00
Thallium	2.00	2.00
Vanadium	154.00	20.00
Zinc	307.00	202.00



TABLE 4-23

CHEMICAL ANALYSES RESULTS OF  
THE SECOND ROUND OF SAMPLING AT GW-01  
WASTE DISPOSAL INC.

Parameter	Filtered Sample Concentration (ug/L)	Non-Filtered Sample Concentration (ug/L)	Non-Filtered Duplicate Sample Concentration (ug/L)	Equipment Blank Sample Concentration (ug/L)
Aluminum	175 L	3630	5570	19.5 L
Antimony	26.5 U	26.5 U	26.5 U	26.5 U
Arsenic	1.5 L	2.7 L	3.6 L	0.8 U
Barium	25.6 L	87.9 L	100 L	5.6 U
Beryllium	1.1 L	2.9 L	3.1 L	0.84 U
Cadmium	4.5 U	4.5 U	4.5 U	4.5 U
Calcium	292000	288000	269000	82.1 L
Chromium	5.3 U	5.3 U	5.3 U	5.3 U
Cobalt	4.2 U	6.1 L	8.2 L	4.2 U
Copper	16.6 L	27.9	31.1	5.9 U
Iron	79.8 L	5970	8370	16.9 L
Lead	0.70 L	10.4	11.4	2.5 L
Magnesium	92500	92600	86800	41.9 L
Manganese	14.6 L	225	266	4.0 L
Mercury	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	9.0 U	9.0 U	11.0 L	9.0 U
Potassium	4140 L	5590	6230	540 U
Selenium	60.5	53.5	36.0	1.3 U
Silver	6.2 U	6.2 U	6.2 U	6.2 U
Sodium	152000	146000	137000	181 L
Thallium	19.0 U	19.0 U	19.0 U	1.9 U
Vanadium	8.1 U	18.8 U	22.0 L	8.1 U
Zinc	320	346	348	44.3

U Indicates the parameter is not detected above the concentration listed.

L Indicates results which fall between the instrument detection limit and the contract required quantitation limit.

of concern were not found in the samples or they were found at concentrations below the contract required quantitation limits (CRQL). The concentrations of detected metals in the unfiltered samples in the second round of sampling appear to be slightly lower than that from the first round of sampling. In comparing the results of first and second round of samples, no specific reason could be attached to the consistently lower metals concentrations in the results of second round of samples. The duplicate nonfiltered samples show concentrations similar to the original second round samples indicating the consistency of sampling analyses and the integrity of samples during the second round of sample collection.

#### 4.4.3 Onsite Chemical Concentrations

In accordance with EPA's policy, all samples from upgradient and down-gradient of source areas were unfiltered during the first round of sampling. The suspended particles in unfiltered samples are sometimes part of the subsurface formation and may be derived from the surrounding sediments. As a result, the analysis of unfiltered samples, particularly for metals, may not be representative of chemicals which are in true solution, or of groundwater contamination. Nonetheless, this analysis usually results in a conservative estimate of public health risks from drinking groundwater.

Numerous metals were detected in samples collected from groundwater monitoring wells located within the WDI site boundaries (Appendix B). The following discussion summarizes the significance of these results:

- o Aluminum was detected in twenty five (25) of twenty seven (27) groundwater monitoring wells. Twenty three (23) wells show aluminum concentrations above the MCL of 1000 ppb established by the Safe Drinking Water Act. Aluminum was also detected in the upgradient wells.
- o Arsenic, barium, copper, lead, mercury, silver and zinc were found in more than one well but at concentrations below the MCLs.

- o Calcium was found in all wells. Concentration of calcium ranges from 187 to 354 ppm. The highest concentration was found in GW-01 which is an upgradient well.
- o Chromium was detected in nineteen wells but only GW-01 which is an upgradient well and GW-27 which is located near the southern end of the site, contain concentrations above the MCL standard.
- o Cobalt was found in wells GW-01 (49 ppb), GW-09 (21 ppb) and GW-23 (16 ppb).
- o Iron was detected in twenty six (26) wells. Concentration of iron exceeds the MCL standard in twenty four (24) of these wells. The range of iron concentration is from 221 to 79,300 ppb. The highest iron concentration was found in GW-01, an upgradient well.
- o Magnesium was found in all wells. Concentration of magnesium ranges from 59 to 114 ppm. Magnesium was detected both upgradient and downgradient from the site.
- o Nickel was found in eleven (11) wells. The nickel concentration ranges from 24 ppb to 79 ppb. The highest concentration was found in GW-01, an upgradient well.
- o Concentrations of manganese were detected at all wells including the two upgradient wells, GW-01 and GW-02. Concentrations above the MCL standard were found in twenty-four (24) wells. Manganese concentration ranged from 20 to 5,850 ppb. The highest concentrations of manganese were found in GW-13, GW-14, GW-15 and GW-21 with concentrations between 4,010 to 5,850 ppb. The first three of those wells are located downgradient of the reservoir.
- o Potassium was detected in all wells. The concentration of potassium ranges from 5,240 to 18,400 ppb. The highest concentration was detected at GW-01, an upgradient well.

- o Concentrations of selenium were detected in twenty six wells. Twenty five wells had concentrations above the MCL. The highest concentration of selenium was detected in GW-01, an upgradient well.
- o Sodium was detected in all wells. Sodium concentration ranges from 102 to 190 ppm. The average sodium concentration for the two upgradient wells is approximately 140 ppm.
- o Vanadium was detected in ten (10) monitoring wells. The highest concentration of vanadium was found in GW-01, an upgradient well.

Five volatile organic compounds were detected in WDI groundwater (Table 4-24). However, the concentrations of the contaminants are much lower than SDWA MCLs and California Department of Health Services (DHS) action levels. Trichloroethene is the only volatile organic compound found in a concentration (18 ppb) above the MCL standard (5 ppb) in well GW-26. Acetone, a common laboratory contaminant, was found in GW-30. Concentrations of toluene (1-5 ppb) were detected in nine wells. Tetrachlorethene was found in GW-11 and GW-21. Chloroform was found in the wells GW-06 and GW-07.

Four semivolatile organic compounds were detected in WDI groundwater (Table 4-25). Bis(2-chloroethyl)ether was detected at well locations GW-06, GW-07, GW-19 and GW-31. The concentration of this compound range from 260 ppb at GW-06 to 690 ppb at GW-19. A concentration of 36 ppb diethylphthalate was detected in GW-05. Concentrations of Di-n-butylphthalate (2 ppb) were found in GW-07 and GW-31. A concentration of 9 ppb of Di-n-octylphthalate was detected at GW-07. All three phthalate compounds are common lab contaminants.

Pesticides and PCB compounds were not present in detectable concentrations in WDI groundwater samples.

#### 4.5 SUBSURFACE GAS COMPOSITIONS

Subsurface gas compositions and their relationships to subsurface soil conditions will be critical when assessing whether the gases identified pose a long-term health risk if their source is left in place without remediation.

TABLE 4-24

CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS  
IN GROUNDWATER  
WDI SITE

	Sample Location	Value (ug/l)	Detect*	Maximum Contaminant Levels
Acetone	GW-030-001	1100.00	J	N/A
Chloroform	GW-006-001	9.00		N/A
	GW-007-001	8.00		N/A
Tetrachloroethene	GW-011-001	11.00		N/A
	GW-021-001	1.00	J	N/A
Toluene	GW-006-001	2.00	J	100 ppb
	GW-007-001	1.00	J	100 ppb
	GW-008-001	4.00	J	100 ppb
	GW-010-001	3.00	J	100 ppb
	GW-015-001	5.00	J	100 ppb
	GW-019-001	1.00	J	100 ppb
	GW-019-002	4.00	J	100 ppb
	GW-022-001	5.00		100 ppb
	GW-026-001	4.00	J	100 ppb
	GW-031-001	2.00	J	100 ppb
Trichloroethene	GW-026-001	18.00		5 ppb

\* Values are estimated, data is valid for limited purposes. The result are qualitatively acceptable unless otherwise noted.

N/A - Not Available.

TABLE 4-25

CONCENTRATIONS OF SEMIVOLATILE ORGANIC COMPOUNDS  
IN GROUNDWATER  
WDI SITE

	Sample Location	Value	Detect*	Maximum Contaminant Levels
Di-n-butylphthalate	GW-007-001	2.00	J	N/A
	GW-031-001	2.00	J	N/A
Di-n-octylphthalate	GW-007-001	9.00	J	N/A
Diethylphthalate	GW-005-001	36.00		N/A
bis(2-Chloroethyl)ether	GW-006-00	260.00		N/A
	GW-007-001	590.00	J	N/A
	GW-019-001	690.00	J	N/A
	GW-019-002	240.00		N/A
	GW-031-001	280.00		N/A

\* Values are estimated, data is valid for limited purposes. The results are qualitatively acceptable unless otherwise noted.

N/A - Not Available.

Subsurface gas samples were collected from each of the twenty six (26) subsurface gas monitoring wells whose locations were shown in Figure 2-7.

The laboratory results for the twenty six samples and two method blanks are presented in Appendix B. These results indicate that there are large variations in the trace organic gases distributed across the site and to some extent the ratio of major gases identified as well. Figure 4-1 shows the analytical concentrations of chloroform along with trichloroethane, trichloroethene, and tetrachloroethene. Figure 4-2 shows the analytical concentrations of benzene along with trichloroethene and perchloroethene detected. Figures 4-1 and 4-2 have been presented because there appears to be a correlation between the presence or absence of these gases with each other. Figure 4-3 shows the percentage of methane comprised in the total gas volume. This figure is important because methane is often an anaerobic degradation product of organic rich material or waste and could represent an explosion hazard if concentrated inside a confined space like a building.

The analytical results also identified the presence of vinyl chloride in wells VW-4 (73 ppbv) and VW-9 (3300 and 12000 ppbv in replicate samples) adjacent to and within the reservoir and VW-14 (110 ppbv) about 180 feet west of the reservoir. The replicate samples collected from VW-9 showed a large variation in analytical concentrations of vinyl chloride, however this is not uncommon in subsurface gas sampling. The important point is that collection of subsurface gas is difficult to reproduce with much precision.

The presence of other chlorinated hydrocarbon gases like chloroform, trichloroethane, trichloroethene, and tetrachloroethene as well as benzene will also be critical to evaluate as part of the endangerment assessment. The results presented in Figures 4-1 and 4-2 indicate a relatively positive correlation between the presence or absence of these trace organic gases. These gases may be produced in the subsurface from soil or waste present in areas 6, 7, 8 and the reservoir (see Figure 2-12).

A summary of subsurface organic gases detected at the WDI gas monitoring wells are presented in Table 4-26. The detection frequency of these gases range from approximately 4 percent to 100 percent. Tetrachloroethene is the

# LEGEND

- CURB & CONCRETE GUTTER
- ===== ASPHALT ROAD
- TREE
- CATCH BASIN
- MANHOLE
- POST
- TRAFFIC LIGHT
- SIGN
- POWER POLE
- FIRE HYDRANT
- BOLLARD
- POLE FLAG
- DOLPHIN
- POST BARRICADE
- VALVE
- POLE
- BUILDING CANOPY
- ===== BLOCK WALL
- ===== FENCE
- ===== DIRT ROAD
- ===== CONCRETE PAD
- ===== EDGE OF ASPHALT
- ===== RAILROAD
- ===== PAINTED LINE
- ===== WATER LINE, DRAINAGE
- ===== RETAINING WALL
- ===== TREE LINE
- ===== GATE
- ===== GUTTER
- MANHOLE
- GAS MONITORING WELL



SCALE  
APPROXIMATE

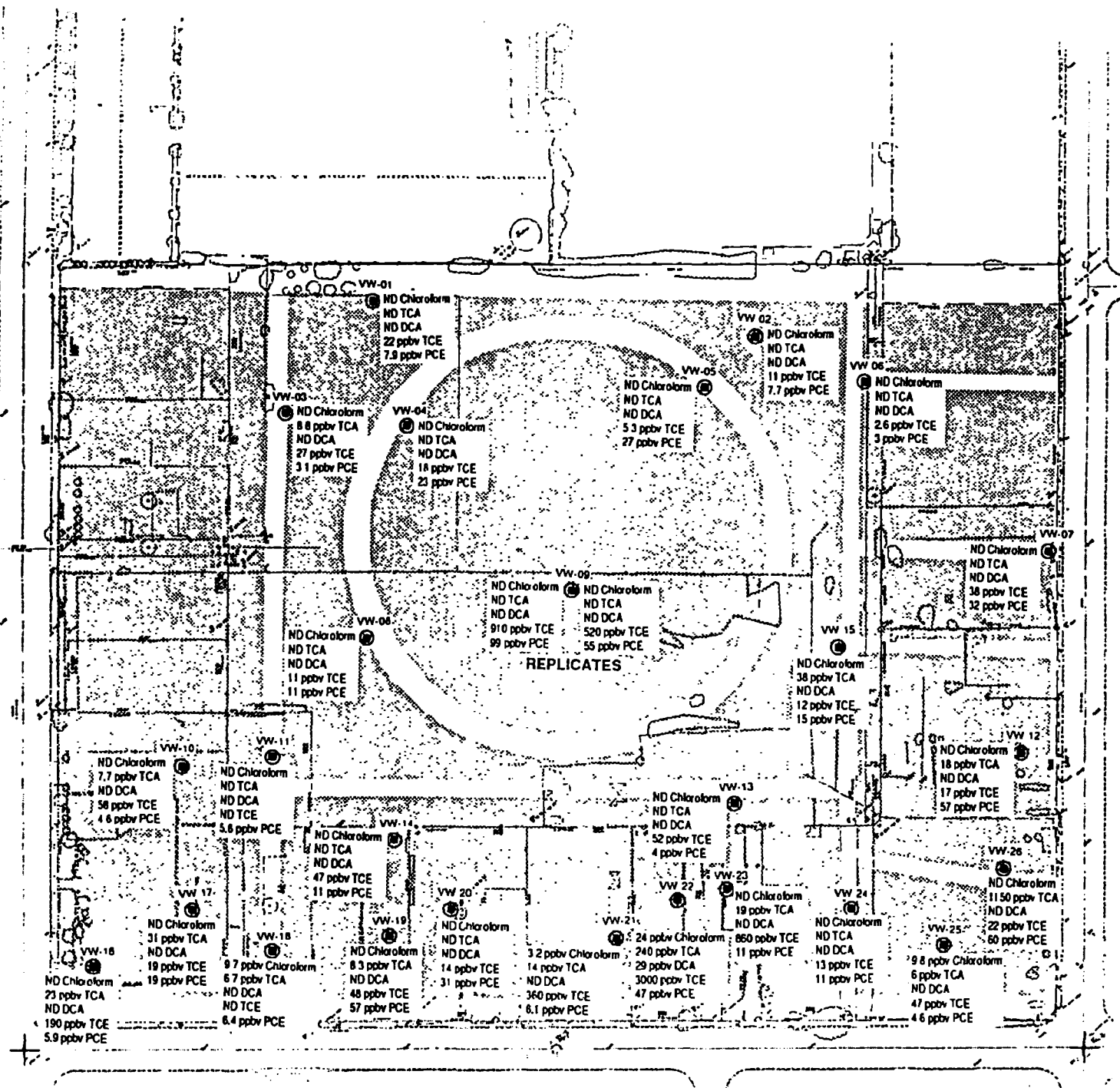
1"=215'

EBASCO SERVICES, INC.

WASTE DISPOSAL, INC. SITE

FIGURE 4-1

CONCENTRATIONS OF  
CHLOROFORM,  
TRICHLOROETHANE (TCA),  
DICHLOROETHANE (DCA),  
TRICHLOROETHENE (TCE), AND  
TETRACHLOROETHENE (PCE)  
IN SUBSURFACE GAS SAMPLES  
COLLECTED IN MARCH 1989  
(ND = Non Detects)





# LEGEND

- DIRT & CONCRETE GUTTER
- ASPHALT ROAD
- TREE
- CATCH BASIN
- MAN-HOLE
- POST
- TRAFFIC LIGHT
- SIGN
- POWER POLE
- FIRE HYDRANT
- BOLLARD
- POLE FLAG
- DOLPHIN
- POST BARRICADE
- VALVE
- POLE
- BUILDING, CANOPY
- BLOCK WALL
- FENCE
- DIRT ROAD
- CONCRETE PAD
- EDGE OF ASPHALT
- RAILROAD
- PAINTED LINE
- WATER LINE, DRAINAGE
- RETAINING WALL
- TRAILLINE
- GATE
- GUTTER
- HANDICAP
- GAS MONITORING WELL



SCALE  
APPROXIMATE

1"=215'

EBASCO SERVICES, INC.

WASTE DISPOSAL, INC. SITE

FIGURE 4-2

CONCENTRATIONS OF BENZENE,  
TRICHLOROETHENE (TCE), AND  
TETRACHLOROETHENE (PCE)  
IN SUBSURFACE GAS SAMPLES  
COLLECTED IN MARCH 1989  
(ND = Non Detects)

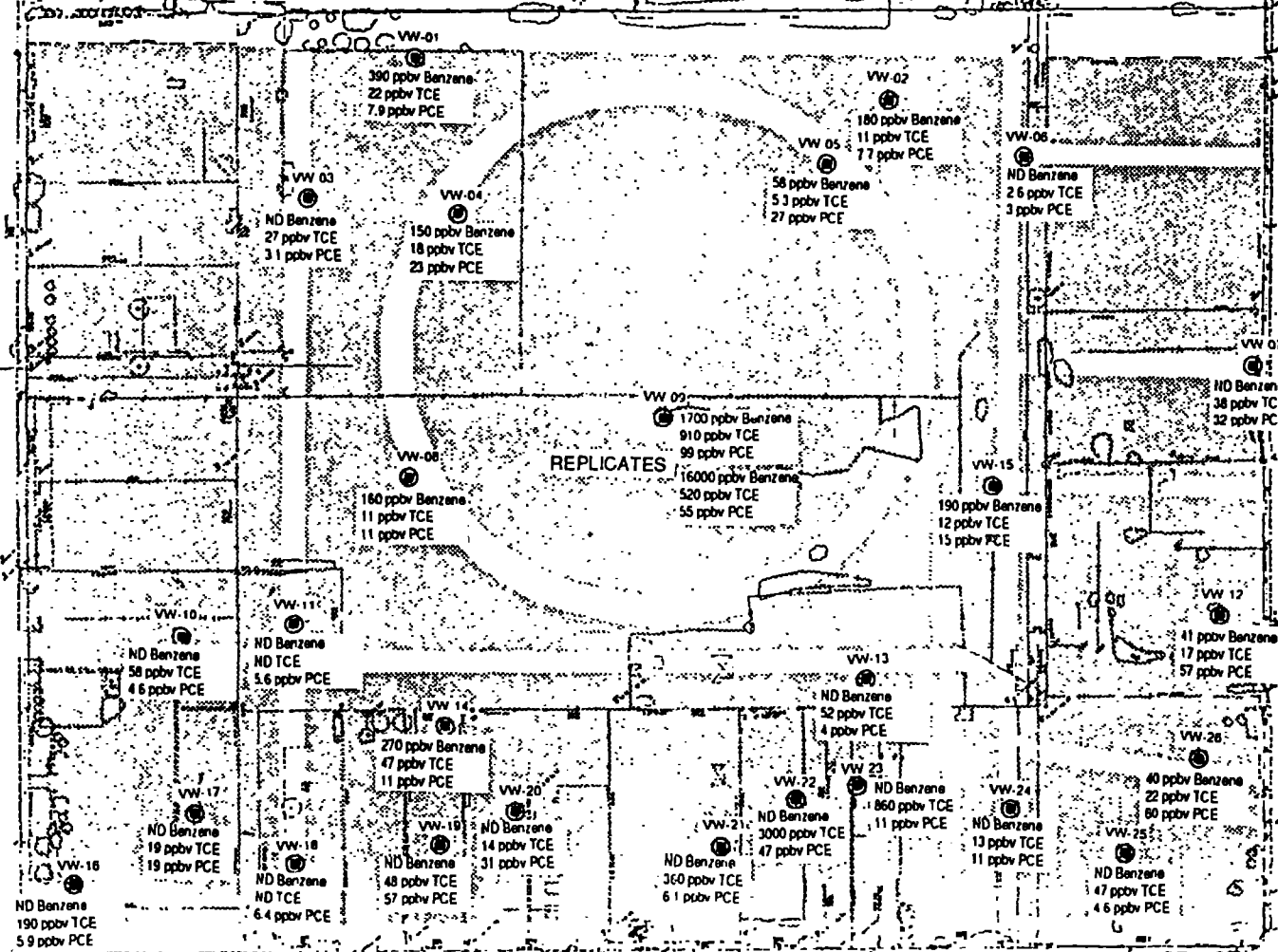




TABLE 4-26

## RESULTS OF SUBSURFACE ORGANIC GASES DETECTED WDI RESERVOIR/WASTE-HANDLING AREAS

Compound	Total Samples	Number of Detects	Detection Frequency	Minimum (ppbv)	Maximum (ppbv)	Median (ppbv)	Standard Deviation (ppbv)	Arithmetic Mean (ppbv)	Geometric Mean (ppbv)
1,1,1-Trichloroethane	26	13	50.00%	2.50	1150.00	2.50	226.82	61.38	7.52
1,2-Dibromoethane	26	21	80.77%	7.00	77.00	15.00	17.96	25.92	20.58
1,2-Dichloroethane	26	1	3.85%	10.00	29.99	10.00	3.73	10.73	10.42
Benzene	26	10	38.46%	10.00	1700.00	10.00	335.32	128.42	29.32
Carbon Tetrachloride	26	1	3.85%	0.25	1.50	0.25	0.25	0.30	0.27
Chloroform	26	4	15.38%	0.50	24.00	0.50	5.11	2.22	0.78
Tetrachloroethene	26	26	100.00%	1.50	99.00	4.00	23.94	21.86	12.88
Trichloroethene	26	24	92.31%	0.50	3000.00	52.00	615.08	223.00	28.51
Vinyl Chloride	26	3	11.54%	10.00	3300.00	10.00	644.34	142.81	14.80

most prevalent organic gas present in the subsurface media at the WDI site. Trichloroethene has the highest average concentration among the detected compounds and vinyl chloride shows the highest concentration of any compounds but it was detected in only three wells.

## 5.0 CONTAMINANT FATE AND TRANSPORT

Environmental fate and transport of chemical elements and compounds are of major importance in evaluating and quantifying the risks resulting from site contamination. The fate of a chemical in the environment and its potential movement are determined by chemical-specific properties and environmental conditions present. Two major factors affecting the fate and transport of a chemical are mobility and persistence. Mobility is a measure of the tendency for a chemical to move through the environment and is affected by: chemical aqueous solubility, volatilization, adsorption, hydrolysis, photolysis, and oxidation. Persistence is a measure of a compound's residence time in the environment. Persistence is influenced by many of the factors affecting chemical mobility but is also a function of chemical-biological interactions in the environment. These interactions are quantified by factors such as biodegradation and/or bioaccumulation.

The factors affecting environmental fate and transport of chemicals are briefly defined below:

- o Solubility is the measure of the quantity of a chemical that is dissolved in water and no longer maintains its original properties. This property is expressed in units of chemical mass/volume of water (e.g., ug/l or mg/l). Aqueous solubility is an important determinant of chemical concentration and residence time in water. Highly soluble chemicals readily dissolve in water and remain in solution whereas chemicals exhibiting low solubility tend to exsolve from solution, binding to particulate matter and/or organics bound to particulate matter.
- o Volatilization describes the vaporization of a chemical from the surface of a liquid or solid matrix to a gas. Volatilization is calculated from the equilibrium vapor pressure which measures chemical solubility in air when the initial chemical concentration is in the liquid phase. These losses to air are correlated with chemical concentration and solubility and ambient temperature.

Volatilization is a particularly important environmental fate process for chemicals exhibiting low aqueous solubility and polarity.

- o Sorption (adsorption/absorption) is the reversible binding of a chemical to a solid or colloidal material. Both nonpolar and insoluble chemicals sorb strongly to sediments, suspended solids and soils. Sorption of these compounds limits the fraction available for other fate processes such as volatilization and/or hydrolysis (e.g., chlorinated pesticides). Partition coefficients, which are generic measures of sorptive characteristics, define the relative concentration of a given chemical in two phases or matrices. These coefficients generally have little basis in reality since they are based on unrealistic experimental conditions.

- o Partition coefficients are expressed as concentration ratios. Partition coefficients that have been used in describing the environmental behavior of a compound include  $K_{ow}$ ,  $K_d$  and  $K_{oc}$  and are defined:

$K_{ow}$ : Ratio of chemical concentration in the organic solvent octanol to that in water at steady state conditions

$K_d$ : Ratio of chemical concentration in aqueous and solid phases at steady state conditions

$K_{oc}$ :  $K_d$  normalized to concentration of organic carbon in solid phase

- o Bioaccumulation is the accumulation and transport of a chemical through the food chain. Potential for bioaccumulation is quantified by bioconcentration factors (BCFs) which define the ratio of pollutant concentration in animal or plant tissue to concentrations of the same chemical in the environmental media of contact, air, water or soil. Chemicals with high BCFs, such as pesticides, are typically insoluble and lipophilic. These compounds tend to reside in animal fat tissue. Literature values of BCFs most commonly pertain to fish species. Since WDI contains no permanent

standing water bodies, bioaccumulative potential of chemicals detected at the site are irrelevant. Bioaccumulation is discussed in these following sections only to complete the fate and transport profile.

- o Biotransformation/Biodegradation: Many microorganisms and biota are resistant to or develop resistance to chemicals, particularly organic chemicals and can transform complex molecules to other compounds. Products of biotransformation/biodegradation may or may not be comparably toxic to other organisms. Biological transformation includes a variety of enzyme-catalyzed reactions such as oxidation and reduction.
- o Hydrolysis is the reaction of a chemical with hydrogen ions ( $H^+$ ), hydroxyl ions ( $OH^-$ ) and water molecules. These components of water interact with or attack sites of a chemical resulting in its subsequent breakdown in the environment. The extent of chemical hydrolytic reactivity depends on both pH and the molecular structure of the specific chemical.
- o Photolysis is a chemical decomposition process induced by radiant energy typically sunlight. The rate of loss of a chemical from photochemical reactions depends on both its molecular structure and the proximity and character of the light source.
- o Oxidation is a chemical reaction which liberates negative electrons from a metal or other substance. Conversely, electrons are consumed in reduction reactions. Both oxidation and reduction reactions are environmentally significant in that they influence the rate of loss of a chemical from environmental matrices. Oxidized and reduced forms of the same chemical may exhibit totally different ecological and/or toxicological properties.

The large number of chemical compounds and metals detected in soil, groundwater, and subsurface gas precludes a detailed evaluation of how each will migrate in the environment. The endangerment assessment has identified

a subset of chemical compounds and metals that potentially pose a health risk. However the large number of these compounds and their interdependence still make it difficult to assess the fate and transport issues.

Relevant Environmental Fate - Data for specific compounds has been discussed where available and is particularly important for the classes of greatest concern. While many compounds have been detected in one or more samples they are neither as ubiquitous nor were detected in the concentrations as those given in the Endangerment Assessment. Sections 5.1-5.3 discuss the environmental processes driving the environmental fate of pesticides inorganic metals, and semivolatiles respectively. These sections describe properties of these chemical classes and briefly account for their presence and/or occurrence at WDI. Section 5.1-5.8 concludes with a summary of the anticipated fate for each of the chemical classes, given both the class- or subclass-specific chemical characteristics, and the environmental features at the WDI site.

Summarizing available environmental fate and transport measures for the class-specific of contaminants detected at WDI, the exhibits include: water solubility, vapor pressure and Henry's Law constants (specific to volatilization rates), photolytic, hydrolytic and oxidation rates (where available), and adsorption factors ( $K_{OC}$  and  $\log K_{OW}$ ) and known biodegradation/bioaccumulation rates (BCFs).

## 5.1 PESTICIDES

Chlorinated pesticides are man-made chemicals characterized by a cyclic structure and a variable number of chlorine atoms. Pesticides were first produced in the early 1940s after discovery of their insecticidal properties. DDT, a stable white amorphous powder, was first synthesized in 1874 but its insecticidal properties were only discovered in 1939. Discovery of the effective insecticidal activity of hexachlorocyclohexane (BHC isomers), chlordane and other pesticides followed shortly thereafter. Production of these pesticides peaked in the early 1960s but has decreased markedly in the last decade due to their extreme persistence and tendency to bioaccumulate. DDT production was banned in 1969. Production/consumption of most other



chlorinated pesticides has decreased similarly with the exception of lindane (gamma-BHC), for which fewer restrictions have been imposed.

Toxo Spray Dust produced a wide spectrum of chlorinated pesticides as described in Section 1. Pesticide wastes dispersed around the site still persist in soils. The chemical properties of pesticides determining relative occurrence and concentration as observed in the WDI RI samples are summarized below.

Water solubilities for the pesticides range from a minimum of  $5.0 \times 10^{-3}$  mg/l for DDT to a maximum of 31.4 mg/l (delta-BHC). With the exception of the beta isomer, BHC pesticides exhibit the highest water solubilities of the chlorinated pesticides while DDT and DDE exhibit the lowest water solubilities. Water solubilities of the remaining pesticides range from 1.0 to  $5.6 \times 10^{-1}$  mg/l. Variations in solubility<sup>6</sup> are due principally to differences in molecular structure, differing polarity (resulting from the degree of chlorination) and/or the presence of other differing functional radicals. In general, no pesticides were found in groundwater at the WDI site and therefore, fate and transport of pesticides in groundwater is not of immediate concern.

Vapor pressures of the chlorinated pesticides range from  $1.8 \times 10^{-4}$  to  $3.0 \times 10^{-4}$  mm mercury and Henry's Law constants range from  $2.07 \times 10^{-7}$  to  $3.2 \times 10^{-4}$  atm-m<sup>3</sup>/mole for the chlorinated pesticides detected (USEPA, 1986), indicating that volatilization may be considered an important environmental fate process at WDI for surface soils. Once volatilized, these compounds would exist in the vapor phase as opposed to being subject to dry deposition, being quickly diluted by ambient air.

Adsorption to soils/sediments or organic matter is the major environmental fate/transport process for a majority of environmental pesticides detected at WDI. The pronounced tendency of chlorinated pesticides to be adsorbed is reflected in the partition coefficients (high  $K_{OC}$  and log  $K_{OW}$  values) exhibited by most of these chlorinated pesticides (USEPA, 1986). The majority of  $K_{OC}$  values range from  $1.1 \times 10^3$  to  $4.4 \times 10^6$  and log  $K_{OW}$  values

range from 3.3 to 7.0. Heptachlor epoxide exhibits similar properties, although to a lesser extent.

Chlorinated pesticides found at the WDI site exhibit wide variability in potential for bioaccumulation. Aldrin and the BHC isomers evidence moderate bioaccumulation with DDE, DDT, heptachlor and heptachlor epoxide exhibit significant bioaccumulation, with BCFs typically ranging from  $3.97 \times 10^3$  to  $5.1 \times 10^4$  l/kg (USEPA, 1986). Nevertheless, lack of aquatic habitat at the WDI site makes this an inconsequential issue regarding the onsite environmental fate of contaminants.

The chlorinated pesticides detected in WDI samples show varying degrees of susceptibility to biodegradation and biotransformation. DDT, DDD, DDE and heptachlor epoxide are all highly resistant to biodegradation. DDT degrades to DDE under aerobic microbial degradation; DDD is the degradation product under anaerobic conditions. Aldrin can be epoxidized to dieldrin by most microorganisms. The BHC isomers (alpha-, beta-, gamma- and delta-) are also susceptible to microbial biodegradation, most notably under anaerobic conditions. Biodegradation data for other pesticides associated with the WDI soils are generally lacking. The general resistance of chlorinated pesticides to microbial degradation suggests that biodegradation/biotransformation is not a significant environmental control for these compounds.

Most chlorinated pesticides either do not hydrolyze or exhibit only negligible hydrolysis under extreme conditions. Pesticides exhibiting some degree of hydrolysis include heptachlor and DDT. The rate of pesticide hydrolysis is strongly dependent upon solution pH. With the exception of these compounds mentioned, hydrolysis is not expected to be a significant environmental fate process for pesticides detected in WDI soil.

Direct photolysis of chlorinated pesticides under natural light is negligible. Indirect photolysis of aldrin, chlordane, DDT, and, heptachlor can occur, but current data concerning photolysis are insufficient and/or conflicting. Consequently, the extent to which photolysis affects environmental fate of chlorinated pesticides and at WDI is inconclusive.

With the possible exception of endosulfan, the chlorinated pesticides associated with WDI production and contamination are relatively resistant to oxidation. Consequently, oxidation is not considered a process which will affect fate and transport of chlorinated pesticides at WDI.

Chlorinated pesticides are highly persistent chemicals which strongly adsorb to soils, sediments and organic matter. As evidenced in their concentrations in surface, shallow subsurface and soil boring data, sorption is the dominant environmental process affecting the fate of pesticides at WDI. Water solubility indicates that groundwater transport is an unlikely mechanism affecting the fate of the compounds at WDI. Chlorinated pesticides have extremely low vapor pressure and as such do not volatilize. The processes of volatilization, photolysis, hydrolysis, oxidation, biomagnification and biodegradation are not likely to be major factors in determining the fate of these compounds either on or off site.

## 5.2 POLY-CHLORINATED BIPHENYLS (PCBs)

PCBs are stable, inert synthetic products used in a wide variety of commercial applications. Dielectric properties make them excellent insulators in transformers and capacitors, which when spilled, emptied or otherwise disposed of improperly constitute a major source of environmental contamination by PCBs.

PCBs exhibit low solubility in water primarily due to their aromaticity. The solubility of PCB 1248 is  $3.10 \times 10^{-2}$  mg/l, approximately the same as the solubility of DDE. Thus, runoff and potential groundwater transport of the PCB's observed in WDI soils/sediments is very unlikely to occur.

Adsorption to soils/sediments or organic matter is a major process defining the environmental fate of PCBs. Like chlorinated pesticides, high affinity for adsorption to organic matter is evident in the high  $K_{oc}$  ( $5.3 \times 10^5$ ) and low  $K_{ow}$  (6.04) partition coefficient values among different PCBs which are correlated with the number of chlorine atoms on the molecule. Consequently, PCB congeners with lower number of chlorine atoms tend to sorb less strongly than the more heavily chlorinated molecules, such as 1248, 1254 and 1260.

Although adsorption can immobilize PCBs in soils and sediments, remobilization via leaching has been observed. The strong adsorptive tendencies of PCBs suggest that most PCBs observed from the WDI field investigation will be tied up in the soil/sediment samples.

PCBs are bioconcentrated in numerous organisms at high levels, binding strongly to lipid (fatty) tissues. The magnitude of the potential binding capacity is expressed in terms of a specific bioconcentration factor. USEPA (1986) has adopted a generalized non-species specific bioconcentration factor of 100,000 which is high and is a reflection of the strong binding capacity. For reasons stated in the introduction of this section, the importance of this process is minimal at WDI.

Biodegradability of PCBs depends heavily upon both the degree of chlorination and the specific position of the chlorine on the biphenyl molecule. In general, mono-, di- and tri-chlorinated biphenyls (PCBs 1221 and 1232) degrade rather rapidly. Tetrachlorinated biphenyls (PCB 1016 and 1242) degrade slowly while higher chlorinated biphenyls (PCBs 1248, 1254 and 1260) are resistant to biodegradation.

Volatilization of PCBs occurs, with fate limited to the vapor phase. Atmospheric removal mechanisms include physically mediated wet and dry deposition, with dry deposition occurring only for PCBs attached to the particulate phase. Consequently, volatilization with concomitant atmospheric recycling via wet and/or dry deposition is a reasonably expected environmental fate process for PCBs.

PCBs are strongly bonded compounds which are not readily hydrolyzed. PCBs may undergo photolysis in the atmosphere where they react with photochemically-produced hydroxyl radicals. However, this is apparently a slow process, particularly for the highly chlorinated congeners (such as PCB 1248). Insufficient data are available to assess the importance of photolysis within aqueous systems. Hence, the extent to which photolytic factors into the ultimate environmental fate of PCBs has yet to be determined. Furthermore, oxidation is not considered to be a significant degradation process for PCBs.

PCBs exhibit high persistence in the environment. This high persistence results from: (1) low solubility in water and air, (2) strong adsorption to soils, sediments and organic matter, (3) the recycling of volatilized PCBs between the atmosphere and surface soils (and water), (4) high tendencies to bioaccumulate and (5) relative resistance to biodegradation. Given the above fate and transport characteristics of PCBs, adsorption is the predominant fate process, with soils as the predominant reservoir of PCBs.

### 5.3 INORGANICS METALS

Numerous metals were detected in the soil/sediment matrices associated with the WDI site. Many of these metals are normal constituents of soil/sediment parental material or common constituents in aqueous matrices due to leaching from soil/sediment. However, several metals detected in WDI soil including arsenic, antimony, copper, lead, mercury, selenium and thallium were present at concentrations that could represent risks to human health based on the Endangerment Assessment. This section will discuss the environmental fate controls for those metals except thallium which have little or no significance at WDI.

Inorganics are ubiquitous in the environment, consisting of a suite of naturally occurring elements such as arsenic, cadmium, lead and zinc. The inorganic form of these metals varies and was not evaluated as part of the RI. Although most inorganics are naturally occurring, their widespread occurrence in the environment is also attributable to manufacturing and refining processes. Additionally, low levels of inorganic metals such as arsenic and lead, are emitted in the burning of most fossil fuels. The main use of arsenic detected at high concentrations in WDI soil was probably a result of pesticide formulation. Inorganic forms of arsenic are often employed in pesticides for their insecticidal and herbicidal properties. Copper, lead, and mercury may be present as part of the oil field wastes disposed of at the site.

Aqueous speciation of metals depends primarily upon the relative stabilities of individual valence states (which are element specific), oxygen content, pH and Eh conditions, and the presence of available complexing agents. The

wide variation of aqueous speciation for the metals associated with the WDI site dictates metal-specific individual discussion.

Arsenic (III) and arsenic (V) valence states, the most common valence states of arsenic present in dissolved salts, depend upon Eh and pH conditions in the natural environment. Additionally, arsenious acid ( $\text{H}_3\text{AsO}_3$ ) and arsenic acid ( $\text{H}_3\text{AsO}_4$ ) can be prevalent forms in aerobic environments under certain conditions. Arsenic (III) may also be formed under limited environmental conditions such as extremely low Eh. Finally, arsenic may exist in soluble organic complexes within aqueous matrices.

Copper (II) is the most prevalent form of copper in aqueous systems since most of the stable cuprous (+1) forms in toxic waters are very insoluble. Exceptions are  $\text{CuCl}_2$ ,  $\text{Cu}(\text{NO}_3)_2$  and  $\text{CuSO}_4$ . Copper may also exist in water as the hydrated divalent cupric ion. However, in general, most copper in aqueous solution is in a complexed form with organic and/or inorganic ligands.

Lead (II) is the most common stable ionic species with hydroxyl, carbonate, sulfide and sulfate anions acting as solubility controls. Under aerobic conditions,  $\text{PbSO}_4$ , and to a lesser extent  $\text{PbCO}_3$ , control lead stability whereas under anaerobic conditions,  $\text{PbS}$  and elemental lead concentrations mediate aqueous lead solubility. Lead may also exist in soluble organic complexes (i.e., humic and fulvic acids) in aqueous matrices.

Mercury exists in the 0, +1 and/or +2 valence states in natural waters, depending upon pH and Eh conditions. Above pH 5 and under moderately oxidizing conditions, the predominant aqueous species is dissolved elemental mercury. Mercury readily complexes with organic matter via biologically and/or non-biologically mediated processes. Consequently, dissolved methylmercury ions and/or undissociated dimethylmercury are commonly encountered in aqueous matrices where mercury is present.

Selenium behaves very similar to sulfur. The predominant soluble specie in oxidized water would be selenate, under reducing conditions selenide would be the stable form. As such selenium would be part of solid solutions with sulfate minerals in the WDI soil.

With the exception of arsenic, lead, and mercury, inorganic compounds do not volatilize under environmental conditions present at the site. Mercury is relatively unique in that the element is capable of volatilizing directly and exhibits a vapor pressure of  $2.0 \times 10^{-3}$  mm mercury. Methylated mercurials (methyl and dimethyl) and, to a limited extent, mercuric sulfides and chlorides also volatilize. Arsenic and lead can be biomethylated. Resulting methylated derivatives of these metals volatilize. Under extremely reducing conditions, arsenic can exist as a volatile arsine gas ( $\text{AsH}_3$ ). However, arsine gas is rapidly oxidized in aerobic conditions.

Volatilization may be an important environmental fate process for arsenic, lead and mercury. Remaining metals associated with the WDI site do not volatilize. Once in the atmosphere, removal of volatilized elemental and/or organo-metallic compounds is principally via wet and/or dry deposition.

Metals exhibit a high adsorptive affinity for inorganic mineral surfaces and organics. Metal adsorption is highly pH dependent with desorption being favored at low pH and sorption mechanisms dominating at high pH conditions. Additionally, chemical speciation determines the relative degree of adsorption among the different species of a particular metal.

Arsenic is adsorbed principally onto clays, aluminum hydroxides, iron oxides and organic compounds. In general, pentavalent arsenic has a greater adsorptive affinity than trivalent arsenic. For arsenic, adsorption is most important in aerobic, acidic fresh water with adsorption decreasing above pH 9 for  $\text{As(III)}$  and above pH 7 for  $\text{As(V)}$ . In contrast, cadmium is principally adsorbed by clays, organics, carbonates and aluminum and iron oxides with adsorption generally increasing as the pH increases.

Copper is sorbed by clays, mineral surfaces, organics, carbonates and precipitating iron manganese oxides. In general, complexed copper with organic acids is more easily adsorbed by clays and free surfaces than the hydrated cations. Copper adsorption is highly pH dependent and the presence of other anionic species can increase copper adsorption. Lead adsorbs principally to clays, hydrous iron and manganese oxides, mineral surfaces

and organic compounds. Lead absorption is is very pH dependent with low pH conditions favoring desorption. Similarly, mercury is sorbed greatly to many inorganic surfaces and is very strongly adsorbed to organic compounds. Like lead, mercury may be desorbed under low pH conditions. Finally, selenium may adsorb to mineral surfaces and organics; however, it is generally adsorbed when the mineral surface is positively charged at low solution pH's.

Considering the above, it is apparent that adsorption/desorption may be important environmental fate processes for the WDI site.

With the exception of mercury and copper, most metals associated with the WDI site do not readily bioaccumulate.

Biomethylation of lead, arsenic and mercury by microbial populations occurs readily in the environment, under aerobic and/or anaerobic conditions. Biogenic ligands have been reported to form complexes with lead. Biotransformation of copper does not occur and cadmium can be complexed in vivo by polydentate ligands that are normally involved in the binding sites of essential metal ions such as iron, copper, zinc, manganese, etc. Biotransformation could be a significant mechanism controlling the environmental fate of lead, arsenic and mercury at the WDI site.

Arsenic and selenium do not photolyze. Some copper complexes are photosensitive; however, data are insufficient to conclude that photolysis is an important degradative mechanism for copper-containing compounds. Organo-lead compounds are susceptible to photolysis in the atmosphere, particularly if the organo-lead complex is halogenated, with the final photolytic end product being lead oxide. Organo-mercurials may also undergo photolytic degradation. Methylated mercurials are susceptible to photolysis primarily in the atmosphere whereas diphenylmercury compounds have been reported to undergo photolysis within the atmosphere and natural waters. Thus, for copper, lead and mercury, photolysis may be an important environmental fate process.



The metals of concern associated with the WDI site are capable of forming numerous inorganic and/or organic complexes in the natural environment. All of the metals of interest readily form organo-metallic complexes, especially with naturally occurring organic acids such as humic and fulvic acids. Some of the metals associated with the WDI site may also form complexes with inorganic ligands such as carbonates, chloride, hydroxyl and sulfate (i.e., copper, lead, arsenic and cadmium). Mercury typically forms complexes with methyl, amino, and/or sulfhydryl groups, and amino acids and their derivatives whereas selenium generally forms tetracoordinate complexes with water. Thus complexation with various organic and inorganic ligands is a significant environmental fate process for the metals of interest associated with the WDI site.

Precipitation and/or coprecipitation are important removal mechanisms of dissolved aqueous metal species. Coprecipitation with hydrous iron, manganese and/or aluminum oxides may occur for arsenic, lead and copper particularly under non-reducing or basic conditions. Coprecipitation may also occur for selenium with iron oxyhydroxides in environmental matrices. In the environment, copper usually precipitates as malachite ( $\text{Cu}_2(\text{OH})_2\text{CO}_3$ ) whereas lead may precipitate as  $\text{PbCO}_3$  and/or  $\text{PbSO}_4$  depending upon environmental conditions. The principal precipitate of mercury is mercury-sulfide; however this reaction product is only found in reducing environments. In contrast, selenium may precipitate as hydrated insoluble oxides such as alkali selenates.

Considering the above and depending upon numerous vadose zone and aqueous environmental conditions (i.e., pH, metallic and anionic species present, etc.), precipitation and/or coprecipitation can be important environmental fate processes for the metals associated with the WDI site.

With the exception of mercury for which fundamental thermochemical data is lacking, all of the metals of interest associated with the WDI site are capable of undergoing isomorphic substitution with cations, or anions in the case of selenium, present in the lattice structure of sedimentary minerals. This process can be an effective means of removing metals from solution depending upon environmental conditions. Therefore, cation exchange is an

important environmental fate process for metals. Due to the complexities and great variances among individual metals involved in cation exchange reactions discussion of the topic in this document is inappropriate.

The metals associated with the WDI site: arsenic, copper, lead, selenium and mercury are typically persistent within environmental matrices. This persistence is primarily related to recycling mechanisms within environmental matrices for some metals (i.e., mercury, arsenic, lead), removal mechanisms (i.e., precipitation, cation exchange, adsorption, etc.) which decrease mobility and bioaccumulation processes (i.e., magnesium, copper). The extensive chemical speciation of metals in the environment and the range of specific fates and reservoirs lead to a metal occurrence in both solid and aqueous media. Detection of metals (particularly arsenic) in WDI sediments, soils and groundwater is consistent with the environmental fate and transport processes documented for metals.

#### 5.4 SEMIVOLATILE ORGANICS

A number of semivolatile organic compounds were detected in soil and groundwater at the WDI site. The nature and extent of these compounds in soil was evaluated as part of the Endangerment Assessment. Based on the various plausible exposure scenarios three compounds and one class of compounds were identified as posing a potential health risk. These three compounds included di-n-octylphthalate, benzoic acid, pentachlorophenol, and the class of compounds referred to polycyclic aromatic hydrocarbons (PAH's). Due to differences in environmental fate, acid and base/neutral extractable organics are discussed separately.

Acid extractable semivolatile organic compounds of concern in the WDI site soils include benzoic acid and pentachlorophenol. Both compounds consist of a benzene ring with substitution of one or more hydrogen atoms with a carboxylic acid, alcohol, and/or chlorine atom or functional group. These compounds may be present as a result of wood treatment chemical use.

Acid extractable semivolatile organic compounds exhibit relatively high solubility in water due primarily to the polarity of molecular functional

groups. Water solubilities for the acid extractable compounds associated with the WDI site range from  $1.4 \times 10^1$  mg/l (pentachlorophenol) to 10 mg/l (benzoic acid). Consequently runoff and groundwater transport of the acid extractable semivolatile organics detected at WDI are major environmental fate processes.

Semivolatile and extractable organic compounds are capable of volatilizing, although at much lower rates than lighter volatile organic compounds. The acid extractable compounds associated with WDI soil exhibit varying degrees of binding affinity to organic matter.  $K_{oc}$  partition coefficients range from 14.2 to  $5.3 \times 10^4$  ml/g and  $\log K_{ow}$  partition coefficients range from 74.13 for benzoic acid to 5.0 for pentachlorophenol.

Bioaccumulation may represent a significant control on pentachlorophenol present in surface soils at WDI whereas benzoic acid is less susceptible to this process. The BCF for pentachlorophenol is 770 l/kg.

In general, biodegradation by microbial populations is a significant environmental fate process for the acid extractable compounds associated with the WDI site. All of these compounds can be biodegraded relatively rapidly under most conditions.

Hydrolysis is not a significant environmental fate process controlling the acid extractable organics present at WDI. Hydrolysis may occur during sorption to clays for some compounds, but there is a general lack of data on this topic.

Direct photolysis and/or photooxidation via hydroxyl radicals can occur for the phenolic acid extractable compounds in aqueous and/or atmospheric matrices. However, these photolytic processes usually proceed at a slow rate and more typically occur in aerobic environments. While these processes will be important in contaminant reduction mechanisms in the environment, they can be considered to be a minor environmental fate process for this class of compounds at the WDI site.

Oxidation of the acid extractable compounds associated with the WDI site may occur via hydroxyl radicals in aqueous and/or atmospheric matrices, and/or metal-catalyzed oxidation in aerobic matrices. Considering this, oxidation may be an important environmental fate process for the acid extractable compounds associated in soil at the WDI site.

With few exceptions, the semivolatile acid extractable organic compounds associated with the WDI site are not very persistent in environmental matrices. This is primarily due to high water solubility, susceptibility to microbial degradation, low affinity for organic matter and clay, and lack of appreciable bioaccumulation. The few anomalous compounds within this chemical class differ from this generalized trend by exhibiting inhibition of microbial populations, high affinity for organic matter and/or clay.

Base neutral extractables consist of a number<sup>6</sup> of chemical subclasses including: polycyclic aromatic hydrocarbons (PAHs), naphthalene compounds, phthalate esters and nitroso compounds. Most are ubiquitous in the environment, occurring both indigenously and as a result of various manufacturing processes. With the exception of the PAH and phthalate compounds, base neutral compounds in concentrations which would represent a concern were not present.

The solubility of base/neutral semivolatile organic compounds is highly variable as a function of molecular structure, degree of aromaticity and presence and type of functional groups attached to the parent molecule. Generally, solubility is positively correlated with molecular polarity and negatively correlated with degree of aromaticity. With some exceptions, base/neutral extractable semivolatile organics are less soluble than acid extractable compounds.

The solubilities of PAH compounds are very low as are those of the phthalates. Since these compounds exhibit low solubilities it is unlikely that surface water and groundwater transport is not a significant process at the WDI site.

Semivolatile base/neutral extractable organic compounds volatilize, but at a much lower rates than lighter, volatile organic compounds, primarily because

of increased molecular size; smaller molecular sizes result in higher volatility. Given the low vapor pressure of PAH's (i.e., less than  $1.0 \times 10^{-8}$ ), and their high particle adsorption affinity, such PAH's would be expected to be associated with an airborne particulate phase.

Volatilization of these compounds will be a minor or negligible environmental fate process; and dry deposition will be a principal means by which PNAs (associated with the airborne particulate phase) are removed from the atmosphere.

Depending on their particular molecular structure, base/neutral extractable compounds exhibit varying degrees of binding affinity to organic matter and soil particles. PAH's (higher molecular weight) are strongly sorbed, whereas phthalate esters with short aliphatic chains are not strongly sorbed ( $K_{oc}$  range: 2.52-940;  $\log K_{ow}$  range: 1.03-3.29). Therefore, adsorption to organic matter and/or soil particles can be an important environmental fate process, particularly for the higher molecular weight compounds (PAH's) found at the WDI site.

Bioaccumulation data are lacking for many base/neutral extractable organic compounds. Bioaccumulation of polyaromatic hydrocarbons (PAHs) is a transitory process since most PAHs with less than five rings are readily metabolized by higher organisms. Thus, for the WDI site, bioaccumulation will be either an important or insignificant environmental fate process depending upon the specific compound in question.

Biodegradation of base/neutral extractable compounds associated with the WDI site is a significant environmental fate process. These compounds are degraded by microbial populations and/or metabolized by higher organisms relatively rapidly under most conditions.

With the exceptions of the phthalate esters most base/neutral compounds such as PAH's are not susceptible to hydrolytic reactions. While hydrolytic reactions of these two compounds is possible, such reactions typically proceed at slow rates. Therefore, hydrolysis represents an insignificant environmental fate process for base/neutral compounds associated with the WDI site.

Many of the base/neutral extractable compounds in aqueous and/or atmospheric matrices are vulnerable to direct photolysis and/or photooxidation. However, these processes are usually slow and highly compound specific; most base/neutral compounds being at best slightly susceptible to photolysis. Exceptions are base/neutral PAH compounds, which in the dissolved phase may undergo rapid photolysis in aqueous matrices if the water is clear. Low solubility of these compounds in water generally relegates this environmental fate mechanism to one of little importance.

Oxidation of some base/neutral extractable organics (via hydroxyl radicals) found in aqueous and/or soils at the WDI site is possible; however, it is generally a slow, and not a significant transformation mechanism. Thus, the oxidation of base/neutral compounds is not considered to be a significant environmental fate process.

The semivolatile base/neutral extractable organic compounds of concern of the WDI site are relatively persistent in soil matrices. This is primarily because of generally low water solubility, resistance to photolytic, oxidative and hydrolytic degradation, and high affinity for organic matter and soil particles. Several of the compounds in this class may also persist, particularly in soil, as a result of their slow microbial degradation. In addition, some of these compounds may evidence substantial bioaccumulation. However, since most organisms have the ability to metabolize these compounds, including PAH's, this is not a critical issue.

## 5.5 VOLATILE ORGANICS

A number of volatile organic compounds were detected in soil, and to a much lesser extent, groundwater at the WDI site. Of these compounds detected only benzene, benzene derivatives and 2-butanone have been identified as being of potential health risk concern. These compounds include benzene, ethylbenzene, toluene, and xylenes and have very similar chemical behavior in the environment.

The volatiles benzene, ethylbenzene, toluene, and xylene, enter the environment by various mechanisms including controlled emissions from

consumer industries, volatilization from waste dumps and landfills and automobile exhaust. Ethylbenzene is a ubiquitous compound, accounting for approximately 10 percent of the total aromatics detected in air and roughly 1 percent of total organics detected.

Volatile organic compounds exhibit high solubility in water. These relatively high water solubilities are primarily due to small molecular size and high polarity imparted by the carbonyl functional group in the ketonic volatile organic compounds. Considering the highly soluble nature of these compounds in water, runoff and groundwater transport of non-chlorinated volatile organic compounds will be a principal environmental fate process.

As the vapor pressure and Henry's Law constants indicate, volatile organic compounds are readily transported into the atmosphere from soil and water. These compounds have relatively high vapor pressures thus volatilization will be a major environmental fate process for these compounds at the WDI site.

With the exception of ethylbenzene, adsorption to soils/sediments or organic matter is not a significant environmental fate process for the volatile organics present in soil at the WDI site. Ketones typically exhibit very low  $K_{OC}$  and  $\log K_{OW}$  coefficients. In contrast, ethylbenzene exhibits high affinity for adsorption to organic matter, as reflected in the relatively high  $K_{OC}$  of  $1.1 \times 10^3$ . Similar benzene derivative compounds typically exhibit relatively low  $K_{OC}$  partition coefficients, indicating a low affinity for adsorption to organic matter. These data coupled with high water solubility and volatility of these compounds make adsorption an insignificant environmental fate process in relation to water and airborne transport mechanisms except for ethylbenzene.

Volatile organics do not bioaccumulate appreciably in aquatic organisms. BCFs for non-chlorinated volatiles detected at WDI typically are very low thus the bioaccumulation of non-chlorinated volatile organics is not a significant environmental fate process for this subclass of chemicals.

Biodegradation of volatile organic compounds occurs via microbial populations and/or higher organisms and is generally a slow process particularly for the larger aromatic compounds. Hence, it is not typically an important environmental fate process.

Hydrolysis of volatile organic compounds is negligible. Atmospheric photooxidation mediated by hydroxyl radicals is the predominant photolytic process affecting non-chlorinated volatile organic compounds. However, this photolytic degradation process is usually negligible due to slow removal rates. Direct photodissociation with aqueous and/or atmospheric matrices is typically insignificant or negligible.

Direct oxidation of non-chlorinated volatile organics associated with the WDI site is not generally a significant process in natural environments. Photooxidation within the troposphere is the predominant degradation removal process.

Non-chlorinated volatile organic compounds are in general not very persistent in the environment due to high volatility, low adsorption to soils excluding ethylbenzene, low bioaccumulation and high water solubility. All of these attributes make non-chlorinated volatile organic compounds highly mobile and transient in environmental matrices.



## 6.0 SUMMARY AND CONCLUSIONS

The RI program implemented at the WDI site was focused on the physical and chemical characteristics of soil, groundwater and subsurface gas. The RI activities have evaluated the presence of various constituents that are of health risk concern and assessed the environmental fate and transport of these constituents. The detailed results of these activities were presented in previous sections. A summary of the RI results and the conclusions reached from this study are provided below.

### 6.1 NATURE AND EXTENT OF CONTAMINATION

Subsurface soil is the most prevalent contaminated medium at the WDI site. Chemical contamination in the WDI soil is widespread and much of it can be classified as hazardous in accordance with RCRA or the California Code of Regulations (See Section 4.3.1). The location of contaminants either on the surface or near groundwater, may constitute a potential threat to public health.

The WDI reservoir and waste handling areas are the major areas of contamination. The reservoir is 585 feet in diameter and 18 to 23 feet deep (Table 6-1). The reservoir is covered by 5 to 15 feet of "relatively clean" artificial fill, underlain by sumpy black mud and sludge. The WDI waste handling areas are from 100 to 900 feet in width and 15 to 30 feet in depth (Table 6-2). Although many are overlain by fill material, the depth of this material varies.

Other observations relative to WDI soil contamination include the following:

- o Pesticides/PCBs are present at shallow depths.
- o Volatile organic compounds, predominantly benzene, toluene, and xylene are present at all depths.
- o Semivolatile organic compounds are present at all depths.

TABLE 6-1

PHYSICAL AND CHEMICAL CHARACTERISTICS  
WDI RESERVOIR

Diameter: 585 feet  
 Depth: 18 to 23 feet  
 Lining: Concrete (Type or extent of reinforcement unknown)

Metals	Pesticides	Semivolatiles	Volatiles
Aluminum	Dieldrin	1,2-Dichlorobenzene	1,1,1-Trichloroethane
Arsenic	Heptachlor epoxide	1,4-Dichlorobenzene	1,1-Dichloroethene
Barium	alpha-Chlordane	Anthracene	Benzene
Cadmium	gamma-Chlordane	Benzo(a)pyrene	Ethylbenzene
Calcium		Fluorene	Methylene Chloride
Copper		Naphthalene	Tetrachloroethene
Lead		Phenanthrene	Toluene
Magnesium			Xylene
Molybdenum			Vinyl Chloride
Nickel			
Sodium			
Thallium			
Vanadium			
Zinc			

TABLE 6-2

## MAJOR CHEMICAL COMPOUNDS PRESENT IN WDI RESERVOIR AND WASTE HANDLING AREAS

	Reservoir	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	School
● Metals										
Arsenic	X	X	X	X	X	X	X	X	X	X
Cadmium	X	X	X	X	X	X	X	X	X	X
Chromium	X	X	X	X	X	X	X	X	X	X
Copper	X	X	X	X	X	X	X	X	X	X
Lead	X	X	X	X	X	X	X	X	X	X
Mercury	X	X	X	X	X	X	X	X	X	X
Selenium	X	X	X	X	X	X	X	X	X	
● Volatile Organics										
2-Butanone	X	X	X	X	X	X	X		X	
Acetone	X	X	X	X	X	X	X	X	X	X
Benzene	X		X		X		X			
Chloroform		X		X		X				X
Ethylbenzene	X		X		X		X	X	X	
Methylene Chloride	X	X	X		X		X	X	X	
Toluene	X	X	X	X	X	X	X		X	
Xylene (total)	X	X	X		X		X		X	
● Pesticides and PCB's										
4,4'-DDD	X	X	X						X	
4,4'-DDE	X	X	X						X	
4,4'-DDT	X	X	X			X			X	
Aldrin			X							
Aroclor-1016										
Aroclor-1221										
Aroclor-1232										
Aroclor-1242										
Aroclor-1248	X		X				X			
Aroclor-1254	X	X								
Aroclor-1260	X	X								
Dieldrin	X				X					
Heptachlor		X			X					
Heptachlor epoxide	X									
Toxaphene										
alpha-BHC										
alpha-Chlordane	X	X	X							
beta-BHC										
delta-BHC									X	
gamma-BHC (Lindane)		X								
gamma-Chlordane	X	X	X						X	
● Semi-Volatiles Organics										
Acenaphthene	X		X		X					
Acenaphthylene	X		X				X			
Anthracene	X	X	X		X				X	
Benzo(a)anthracene	X	X	X	X	X					
Benzo(a)pyrene	X	X	X	X	X			X	X	
Benzo(b)fluoranthene	X		X	X	X				X	
Benzo(g,h,i)perylene	X	X	X		X				X	
Benzo(k)fluoranthene	X				X					
Benzoic Acid	X	X	X		X		X			
Chrysene	X	X	X	X	X			X	X	
Di-n-butylphthalate	X	X	X	X	X	X	X		X	
Di-n-octylphthalate	X	X	X		X		X		X	
Dibenz(a,h)anthracene		X								
Fluoranthene	X	X	X	X	X		X			
Fluorene	X	X	X		X				X	
Indeno(1,2,3-cd)pyrene		X	X		X				X	
Naphthalene	X	X	X		X				X	
Pentachlorophenol		X	X							
Phenanthrene	X	X	X		X				X	
Pyrene	X	X	X	X	X	X	X	X	X	
bis(2-ethylhexyl)phthalate	X	X	X	X	X	X	X	X	X	

- o Several borings in the southern portion of the WDI reservoir did not encounter the concrete which composes the reservoir bottom elsewhere. These borings also detected the same types and concentrations of contaminants directly below the reservoir as were detected within the reservoir. These borings may have been placed outside the reservoir or the reservoir concrete bottom may be below the borings drilled depth.
- o The eight waste handling areas on the site are unlined although the solidification of contaminants, the natural stratigraphy, or both may be limiting contaminant migration.
- o Contamination in areas of the site which are outside the WDI reservoir and waste handling areas is relatively low.
- o The subsurface soil on the Toxo Spray Dust and Campbell properties both contain contamination which is similar in type to the contamination in the WDI reservoir and waste handling areas, but is somewhat lower in concentration.

The results of chemical analyses of groundwater samples from WDI indicate that metals are the most widespread of contaminants. Metals were detected both upgradient and downgradient of the WDI reservoir. Highest concentrations of metals were found in the upgradient wells.

Other findings of the groundwater characterization study are shown in Table 6-3. They include:

- o Monitoring well GW-26 was the only well that showed contamination by trichloroethene above the MCL standards. None of the other monitoring wells showed any contamination by volatile organics.
- o Bis (2-chloroethyl) ether was the only semivolatile organic compound that was detected at more than one well but it was not found consistently throughout the site.

TABLE 6-3  
CHEMICAL COMPOUNDS FOUND IN THE WDI GROUNDWATER

GW-Well	Location <sup>a</sup>	NUMBER OF CONTAMINANTS			
		Metals	Volatiles	Semivolatiles	Pesticides/PCBs
GW-01	B&L (NW of Reservoir)	18	-	-	-
GW-02	Fedco(NW of Reservoir)	15	-	-	-
GW-03	RV Storage (W of Reservoir)	15	-	-	-
GW-04	Reservoir	12	-	-	-
GW-05	Reservoir	12	-	1	-
GW-06	Reservoir	14	2	1	-
GW-07	Reservoir	12	2	3	-
GW-08	RV Storage (NW of Reservoir	15	1	-	-
GW-09	Mersit's Equipment (NW of Reservoir)	18	-	-	-
GW-10	Dia-Log (N of Reservoir)	15	1	-	-
GW-11	Dia-Log (W of Reservoir	10	1	-	-
GW-13	Toxo Spray Dust (SW of Reservoir)	12	-	-	-
GW-14	Terry Trucking (SW of Reservoir)	11	-	-	-
GW-15	H&H Contractors (SW of Reservoir)	16	1	-	-
GW-16	Reservoir (SW of Reservoir)	10	-	-	-
GW-18	Reservoir (SW of Reservoir)	8	-	-	-
GW-19	H&H Contractors (SW of Reservoir)	16	1	1	-
GW-21	Atlas Heat Treating (SE of Reservoir)	14	1	-	-
GW-22	Dia-Log (W of Reservoir)	16	1	-	-
GW-23	Toxo Spray Dust (SW of Reservoir)	18	-	-	-
GW-24	Toxo Spray Dust (SW of Reservoir)	8	-	-	-
GW-26	Timmons Wood	17	2	-	-
GW-27	Rick's Smog (S of Reservoir)	16	-	-	-
GW-28	Campbell Property (S of Reservoir)	16	-	-	-
GW-29	Campbell Property (S of Reservoir)	11	-	-	-
GW-30	Campbell Property (S of Reservoir)	15	1	-	-
GW-31	Reservoir	13	1	2	-

<sup>a</sup> The direction of groundwater flow is toward the southwest.

- o Pesticides and PCB compounds were not detected in any of the monitoring wells.
- o Aluminum, iron, manganese and selenium were found in concentrations exceeding the MCL standards in almost all wells. Both upgradient and downgradient wells showed high concentrations of these metals.

The analytical results of the March 1989 subsurface gas sampling effort indicate that the organic gases shown in Table 6-4 are present beneath the WDI site. Presence of these gases warrants a health risk evaluation. In addition to these organic gases, the presence of methane may be significant if structures or confined spaces are built on the surface.

In general the gases are distributed in and around the reservoir and waste handling areas 6, 7, and 8. The reservoir and immediate surrounding area has subsurface vinyl chloride, benzene, and lower concentrations of chlorinated hydrocarbons as trace constituents in the gas. Methane was also identified in and around the reservoir but not elsewhere except one sample in area 7, one sample in area 8, and two samples within area 1 close to the reservoir. Areas 6, 7, and 8 also contain detectable levels of chlorinated hydrocarbons. However, in general, their concentrations appear to be lower than the reservoir area. These analytical results appear to indicate that waste volatilization or biologic generation of these gases from the waste is occurring in and around the reservoir and in areas 6, 7, and 8.

The present network of subsurface gas monitoring wells was designed to intercept gases that may be generated from waste handling areas identified in aerial photos and by geophysics and is sufficient to identify the sources of subsurface gas generated at WDI. The presence of compounds such as vinyl chloride, benzene, and methane may represent potential health risks.

The endangerment assessment will consider exposure to subsurface gas in the event of on-site soils excavation. In addition to this exposure scenario, it is important to consider whether these gases may migrate to the surface and into the ambient air. Based on several factors, it is theorized that this migration is not occurring. First of all, field instruments used to

TABLE 6-4

## ORGANIC GASES DETECTED AT THE WDI RESERVOIR/WASTE-HANDLING AREAS

Compound	Reservoir	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
1,1,1-Trichloroethane		X	X				X	X	X
1,2-Dichloroethene									X
Benzene	X		X				X		X
Chloroform									X
Methane	X	X	X			X		X	X
Tetrachloroethene	X	x	X		X	X	X	X	X
Trichloroethene	X	x	X		X	X	X	X	X
Vinyl Chloride	X		X						X

3747E

sample ambient air over the reservoir did not detect either methane or non-methane hydrocarbons, despite the elevated levels of methane present in the reservoir and the high mobility of methane. In addition, two samples taken as field blanks collected ambient air, which when analyzed did not show the presence of methane or other trace gases. Finally, the outlying vapor wells have not shown contamination, suggesting that lateral migration of gases from the reservoir area is not occurring.

## 6.2 CONCLUSIONS

Overall, certain contaminants present in the WDI soil may constitute risks to human receptors. Risk reduction could be achieved by remediation of selected contaminant sources. The ranking of source-specific risks will be provided later after the risk assessment is completed. The source ranking is needed for prioritizing remedial activities.

The WDI reservoir is the most contaminated source containing high concentrations of metals and volatile organics. However, most of the contamination appears to be confined within the concrete-lined area. Although the concrete bottom may not be intact in several areas, the contamination has not spread downward to the groundwater. The groundwater under WDI is relatively free of contamination. Certain areas used previously as waste handling areas also contain elevated levels of contamination. These areas are not lined and therefore, waste presence and migration in the subsurface may be considered as a potential health hazard in these areas. However, for the most part soil contamination in these areas appear to be bound to the soils and are relatively immobile. Subsurface gas presence in this area may also pose a health hazard and its remediation may be needed.



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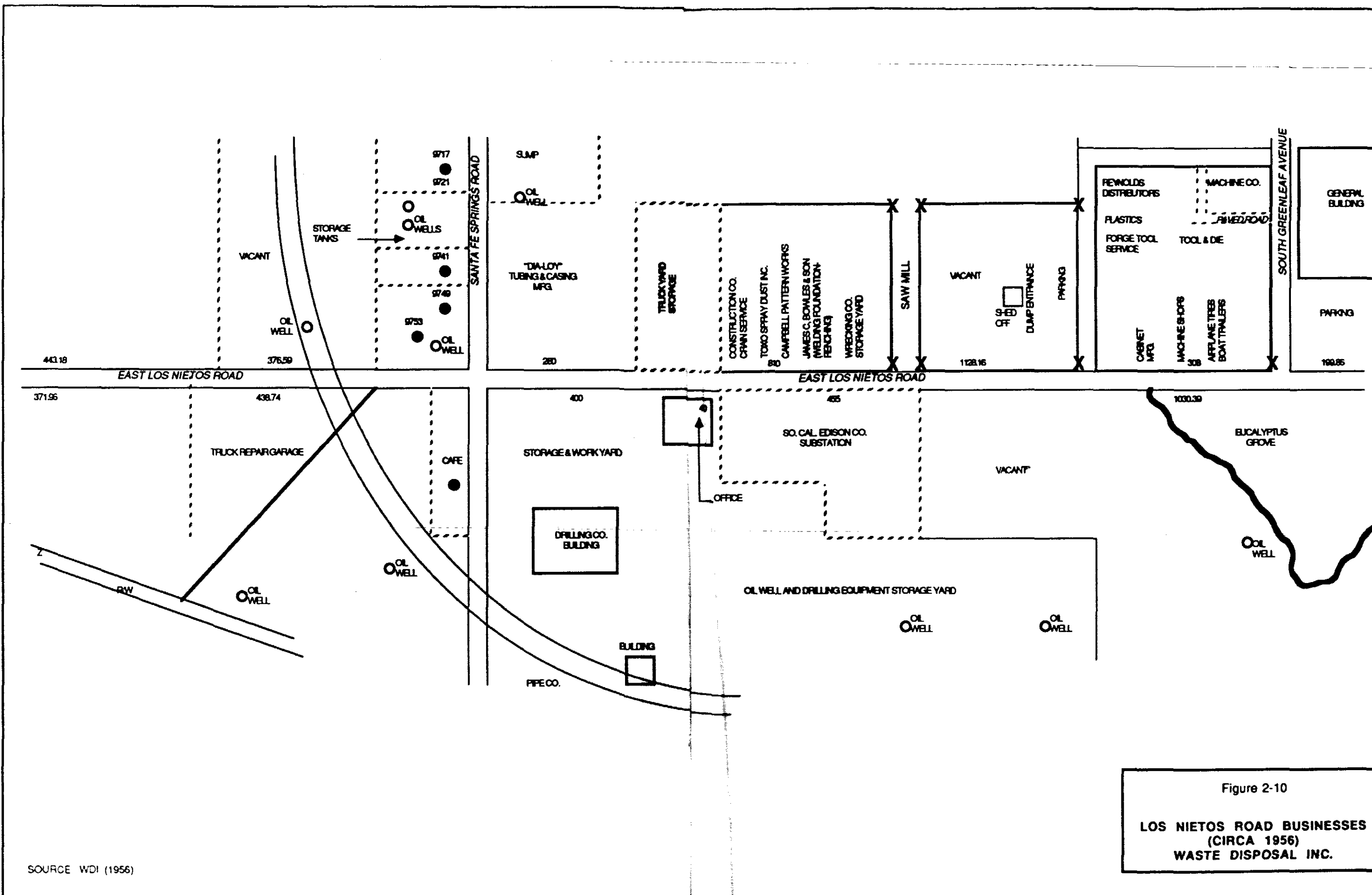
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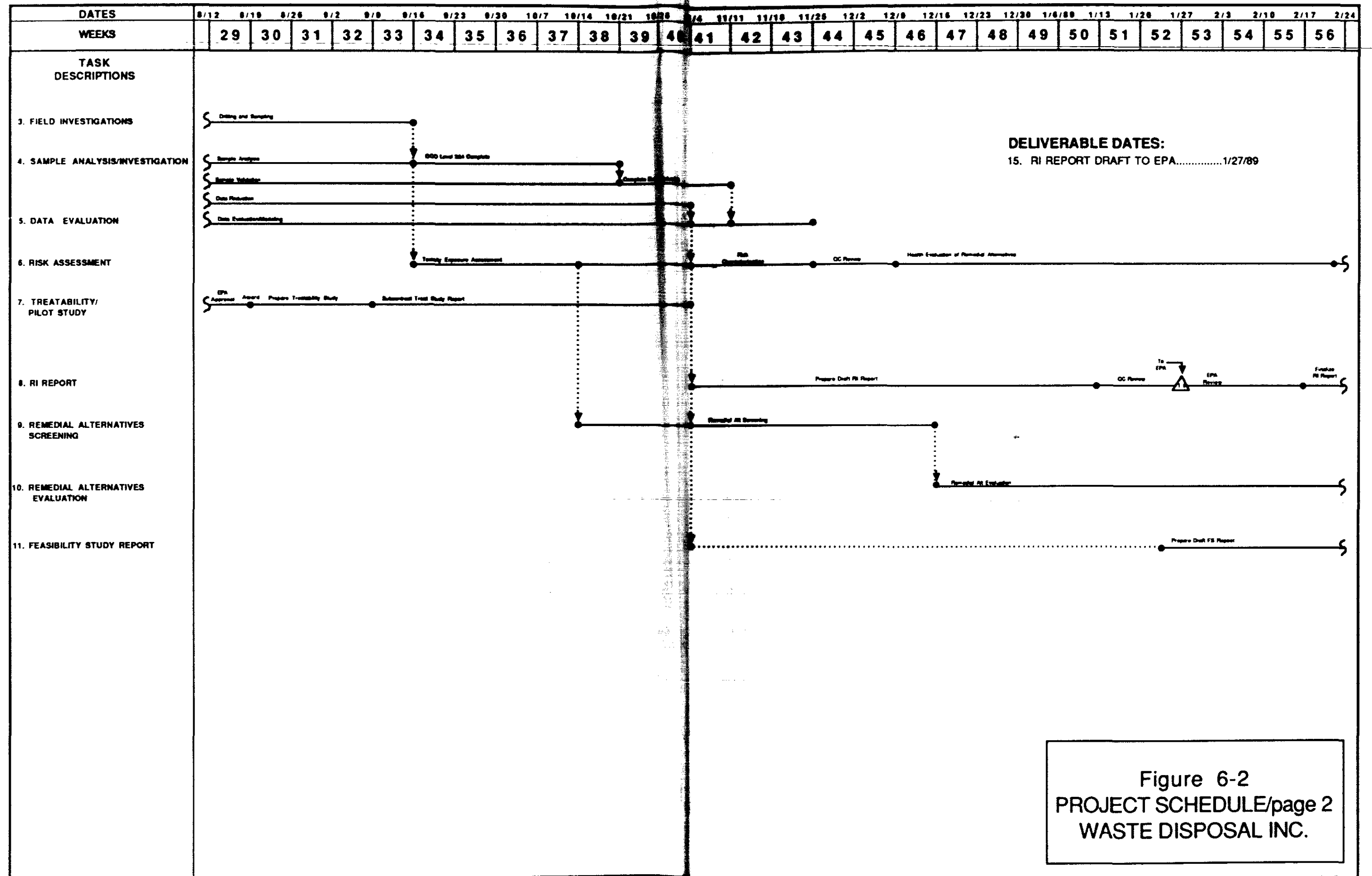
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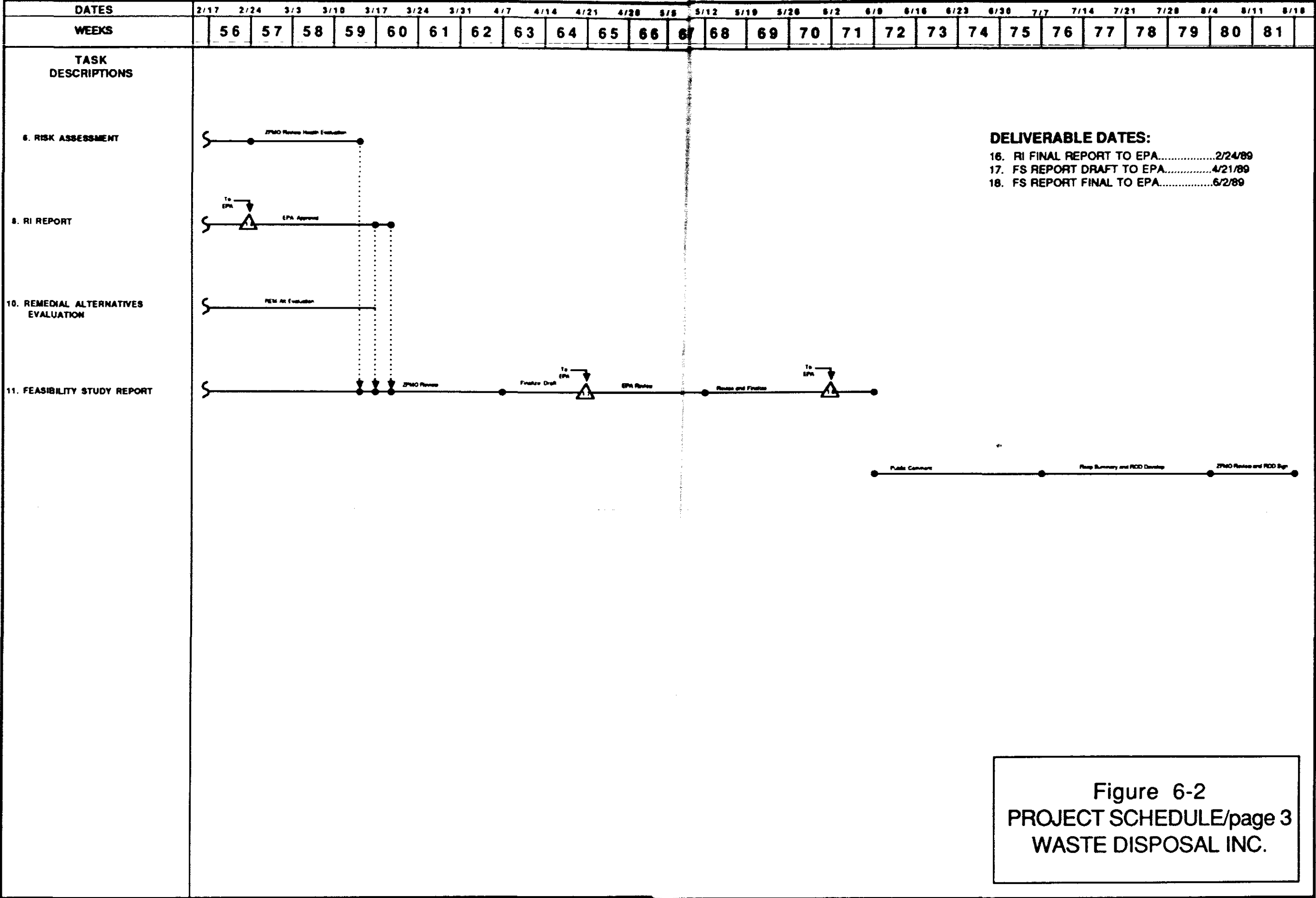
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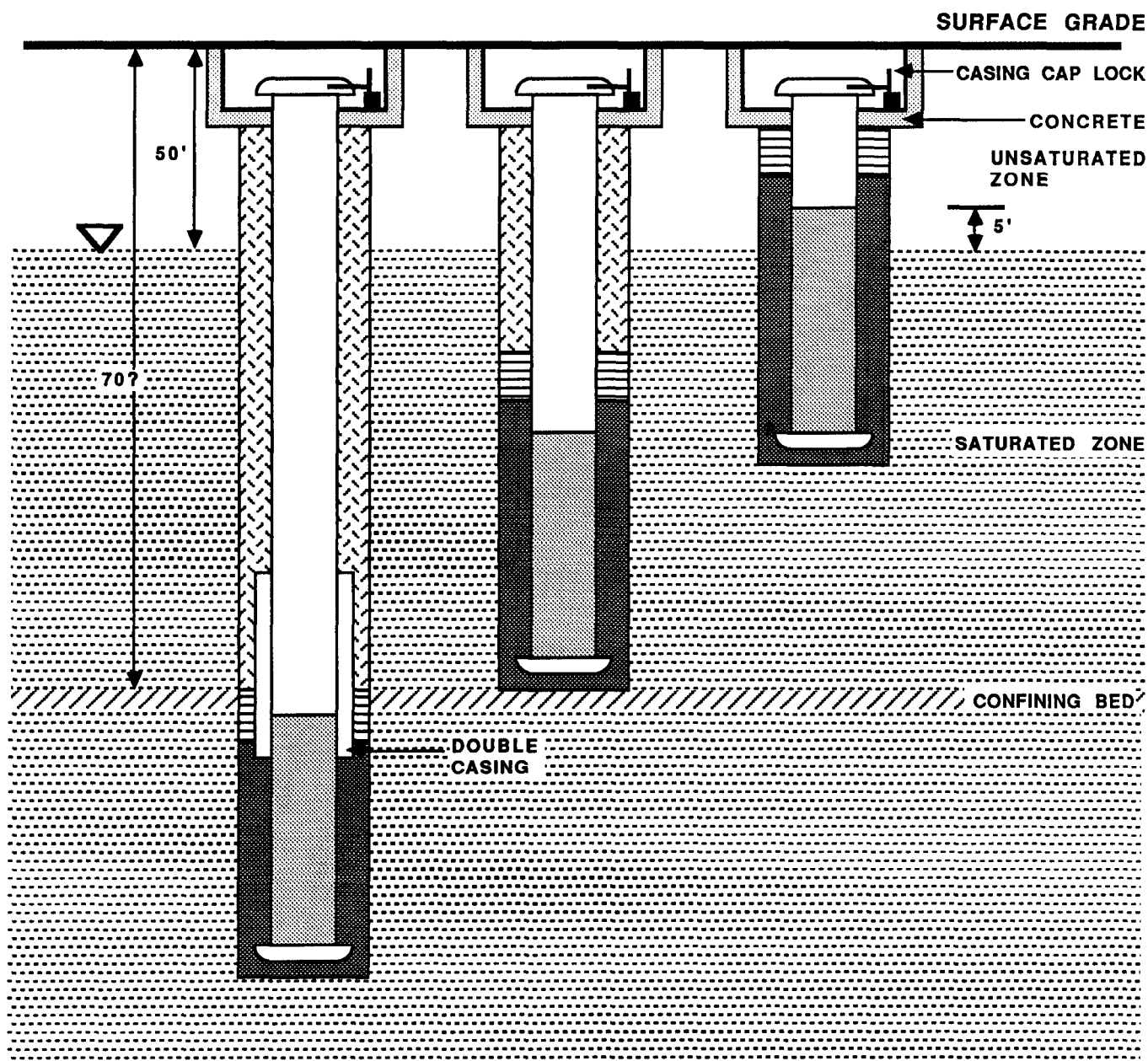
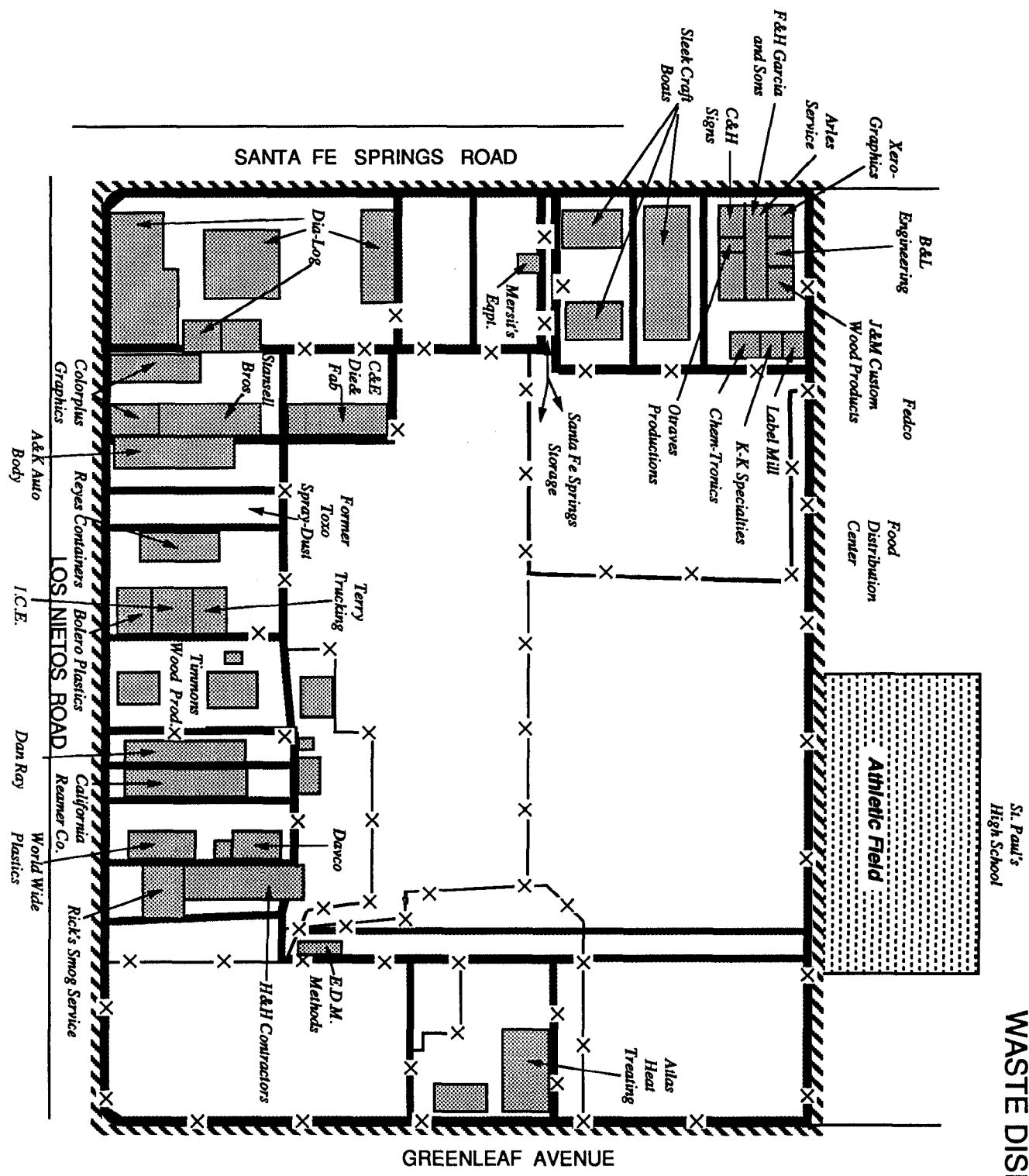


Figure 4-8  
**DESIGN OF TYPICAL  
 TRIPLE WELL CLUSTERS  
 WASTE DISPOSAL INC.**

**Figure X**  
**SITE MAP**  
**WASTE DISPOSAL INC.**



**LEGEND:**

- Existing Buildings
- Parcel Boundary (approximate)
- X-X- Fence
- Site Boundary



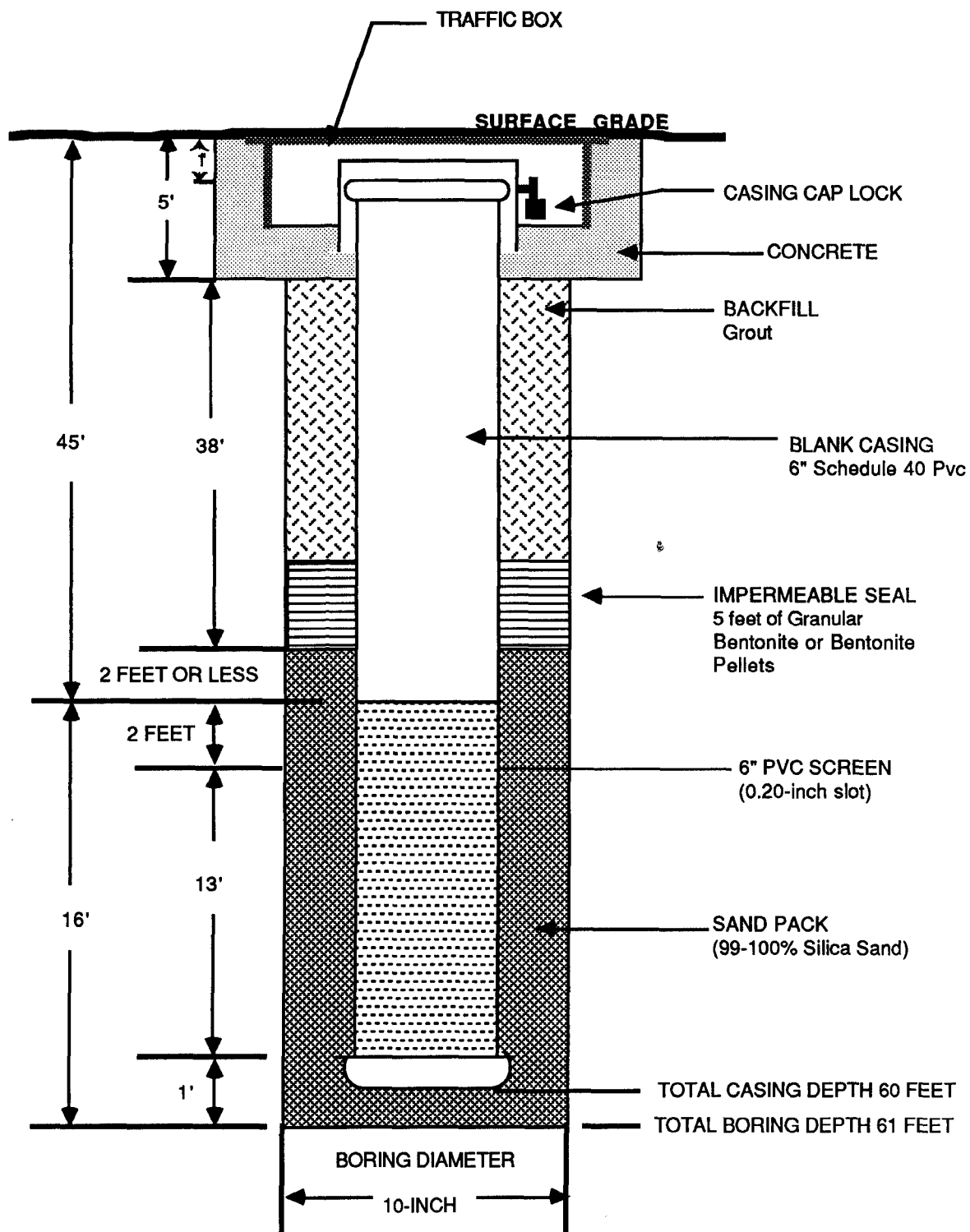
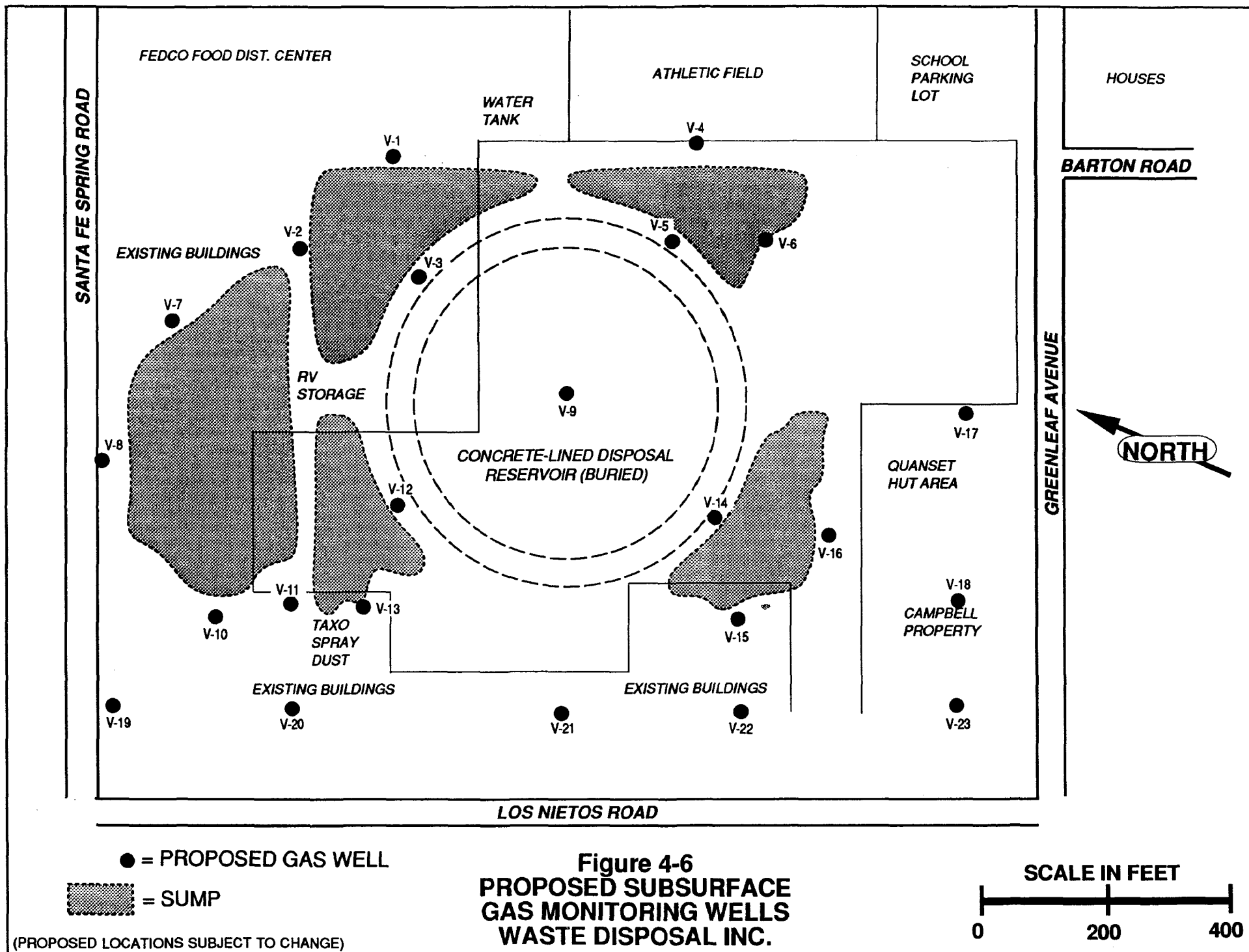



Figure 4-7  
Design of Typical Nonclustered  
Groundwater Monitoring Well  
Waste Disposal Inc.



**LEGEND:**

 = SUMP

 = ELECTROMAGNETIC  
SURVEY LINES

**SCALE IN FEET**

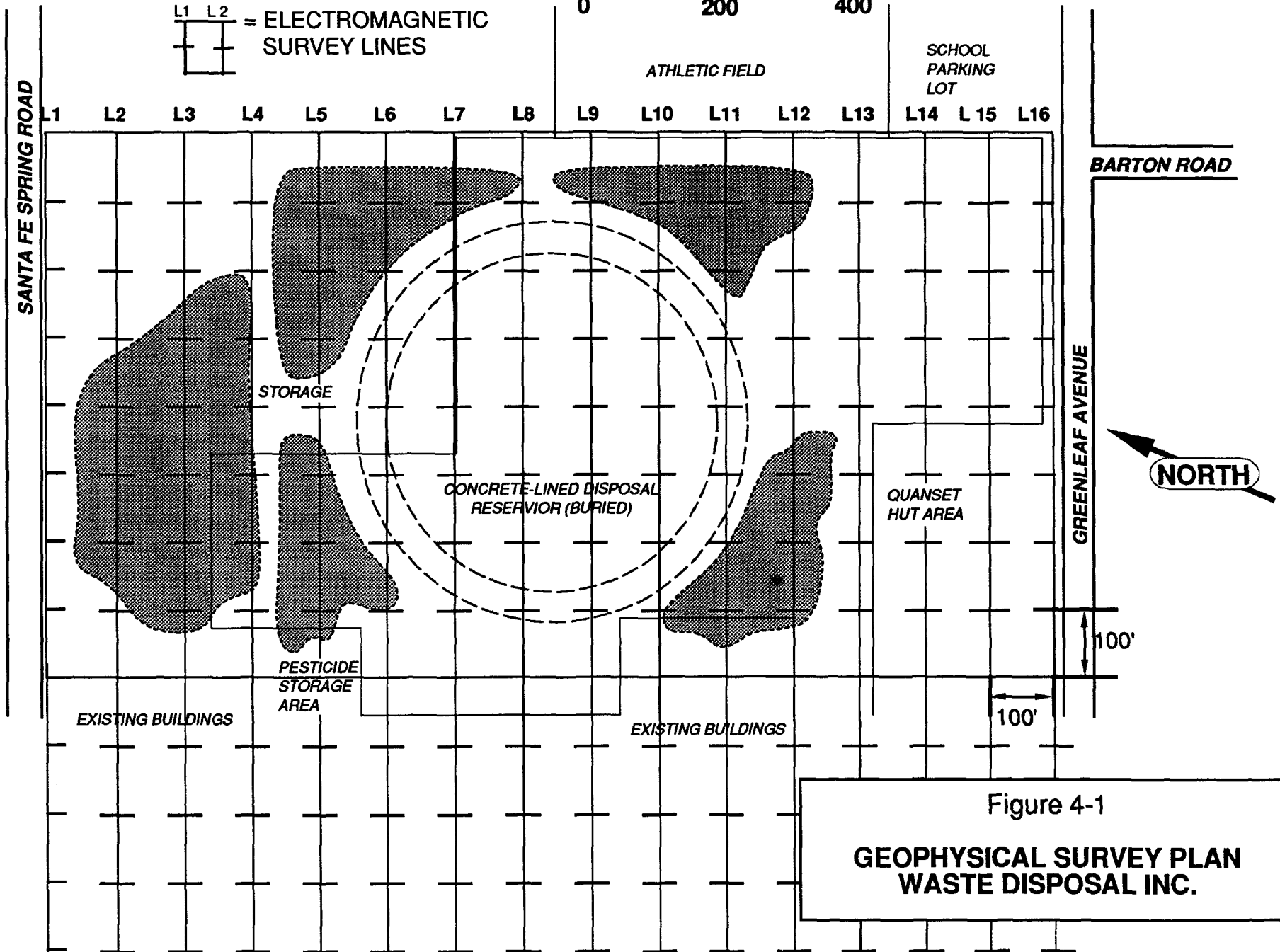
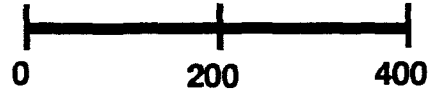


Figure 4-1

**GEOPHYSICAL SURVEY PLAN  
WASTE DISPOSAL INC.**

SANTA FE SPRING ROAD

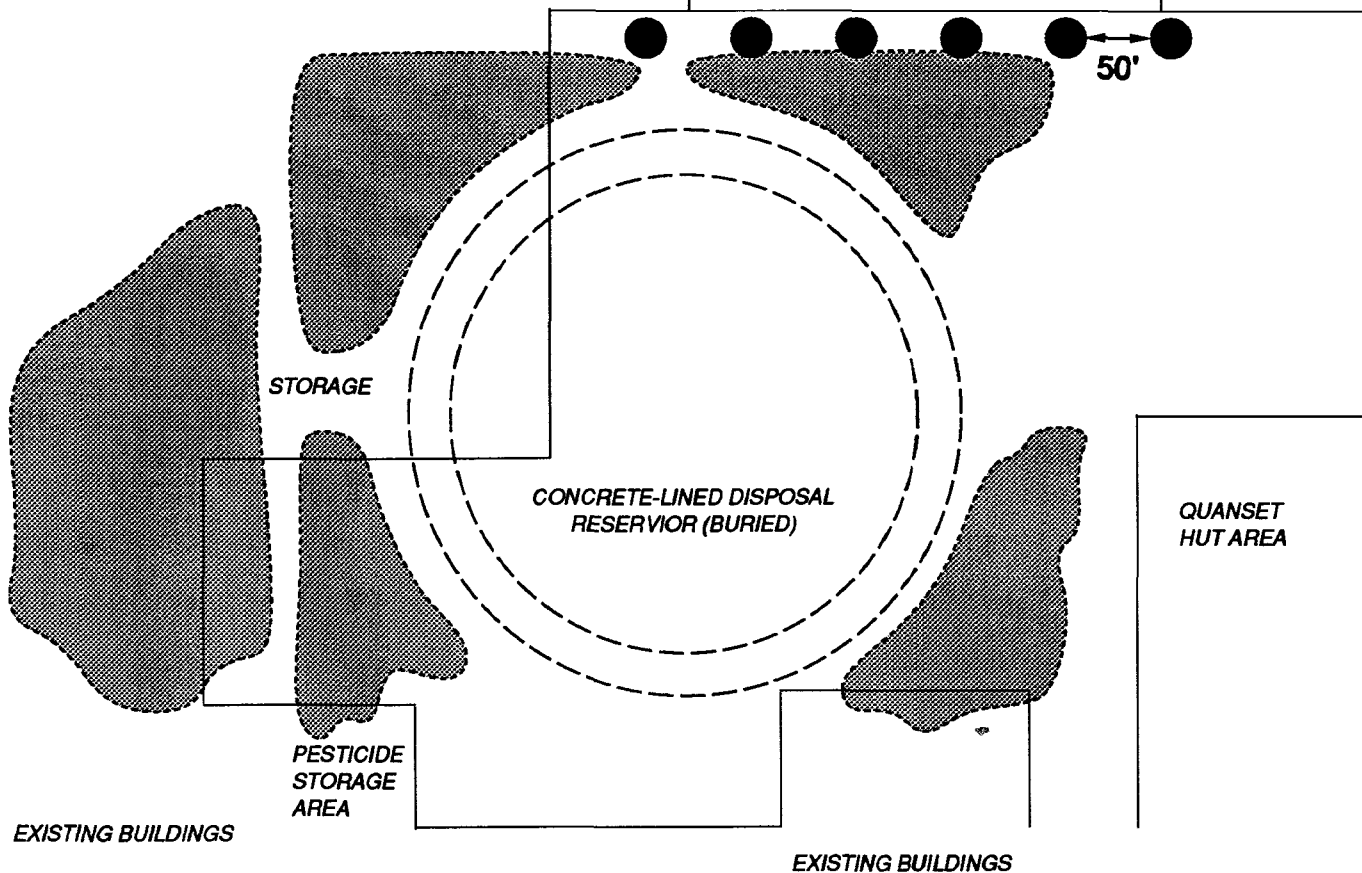
ATHLETIC FIELD

SCHOOL  
PARKING  
LOT


BARTON ROAD

GREENLEAF AVENUE

NORTH



**LEGEND:**

 = SUMP

 = GAS PROBE

SCALE IN FEET

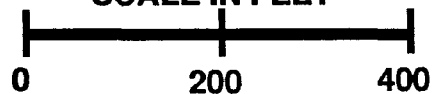


Figure 4-3  
**PROPOSED SUBSURFACE  
GAS PROBE LOCATIONS  
WASTE DISPOSAL INC.**

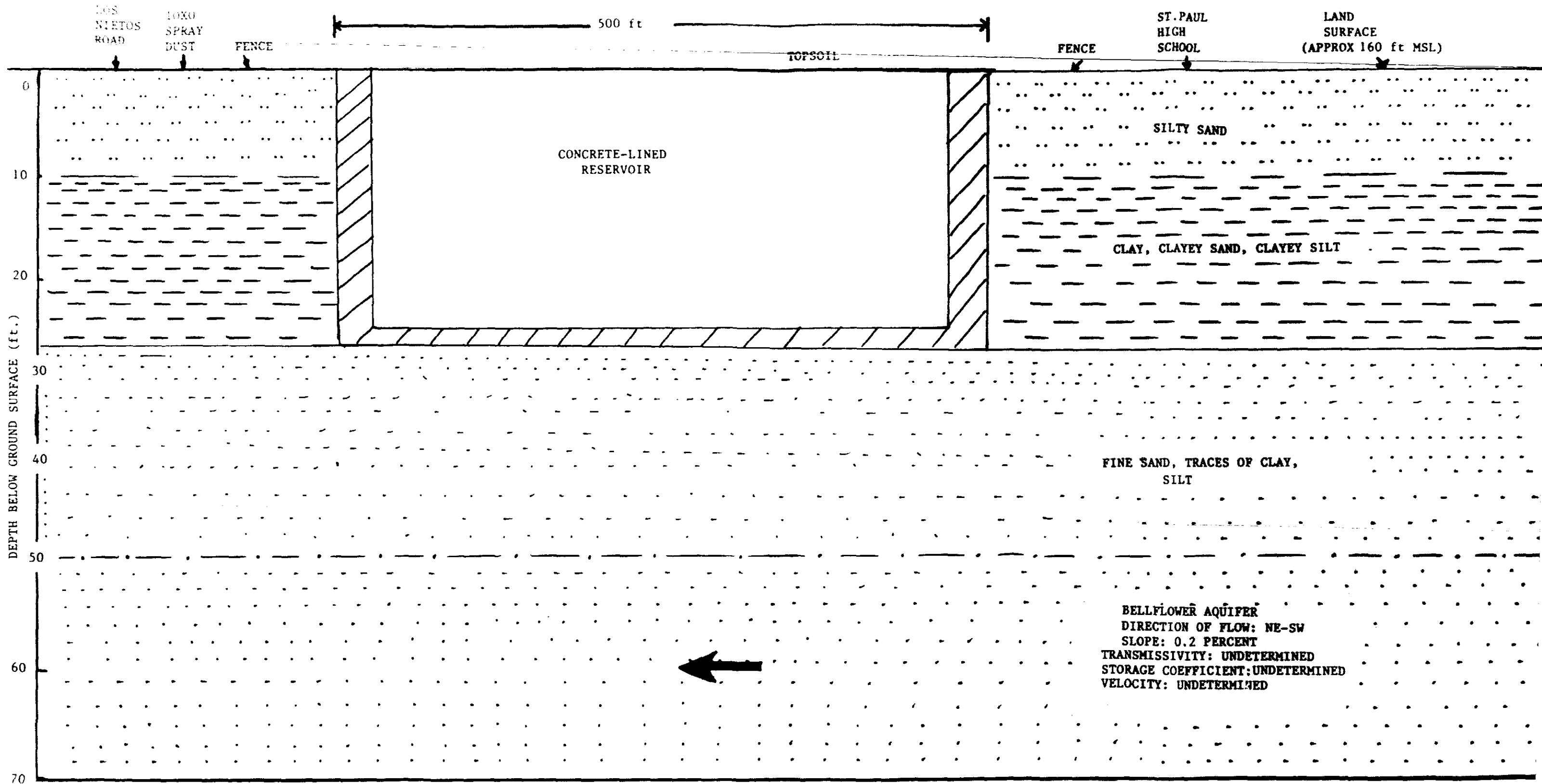
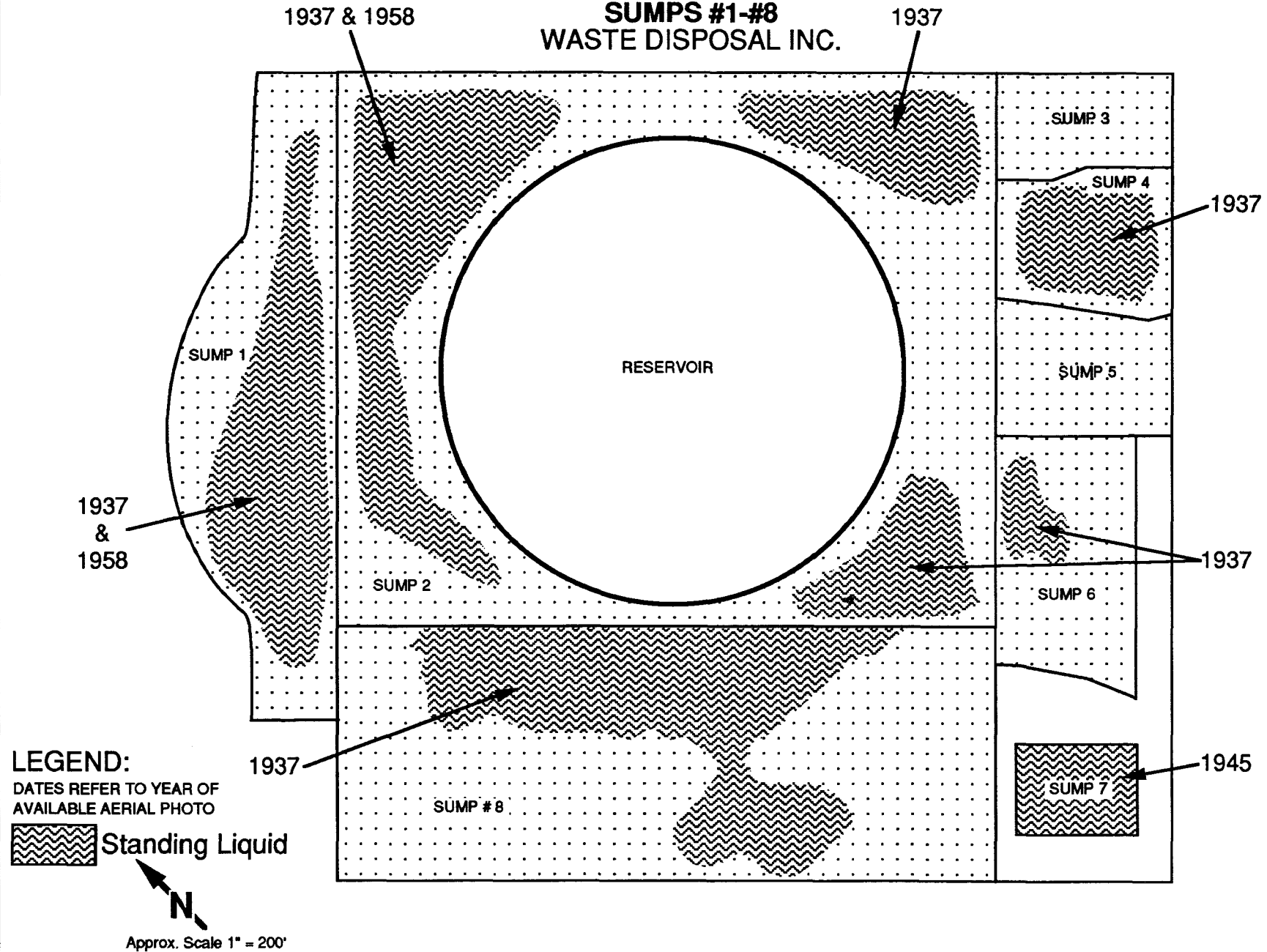
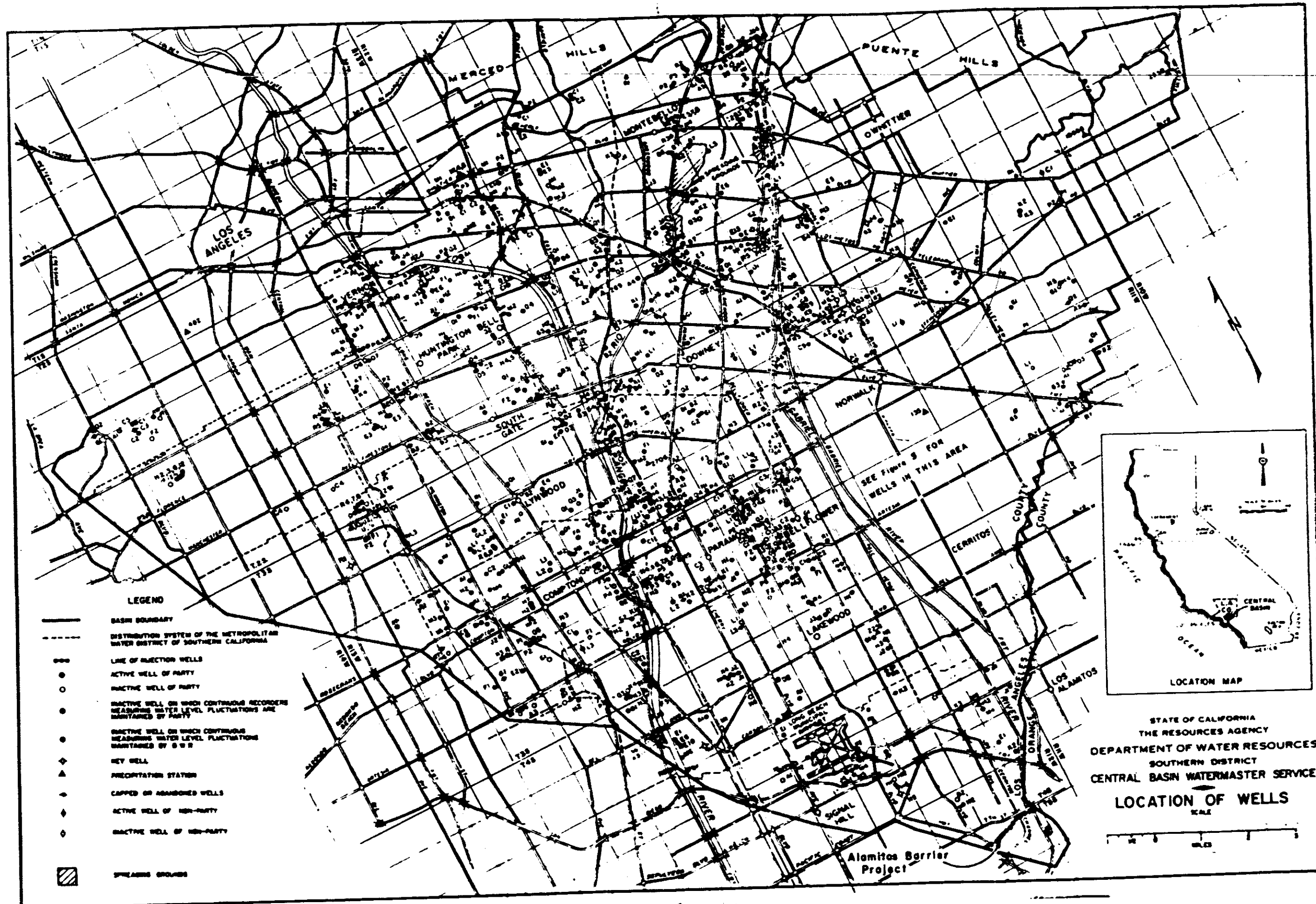




Figure 4-7  
**STANDING LIQUID IN  
 SUMPS #1-#8**  
 WASTE DISPOSAL INC.





## **11.0 REMEDIAL INVESTIGATION REPORT**

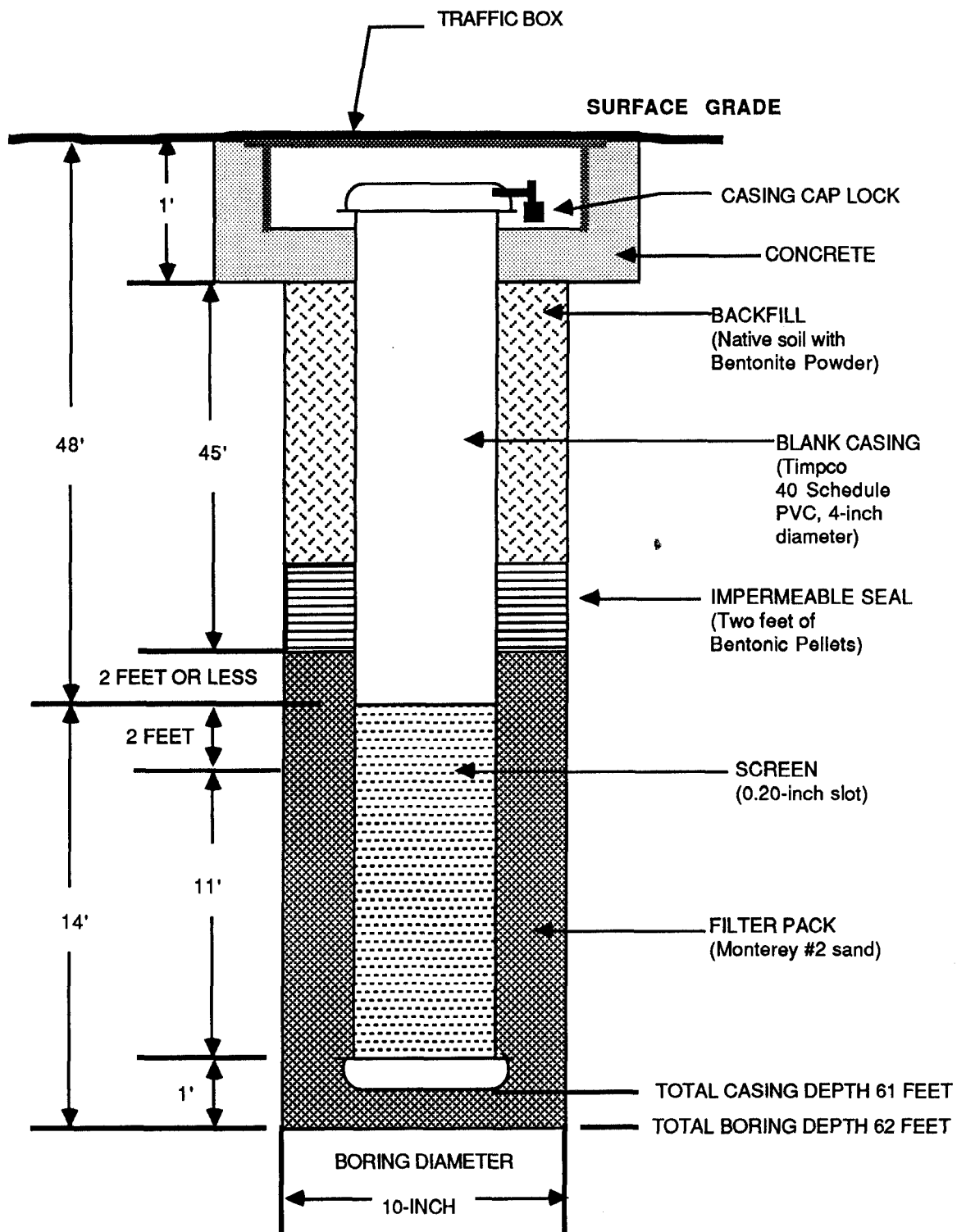


Figure  
Design of Typical Ebasco  
Groundwater Monitoring Well  
WDI

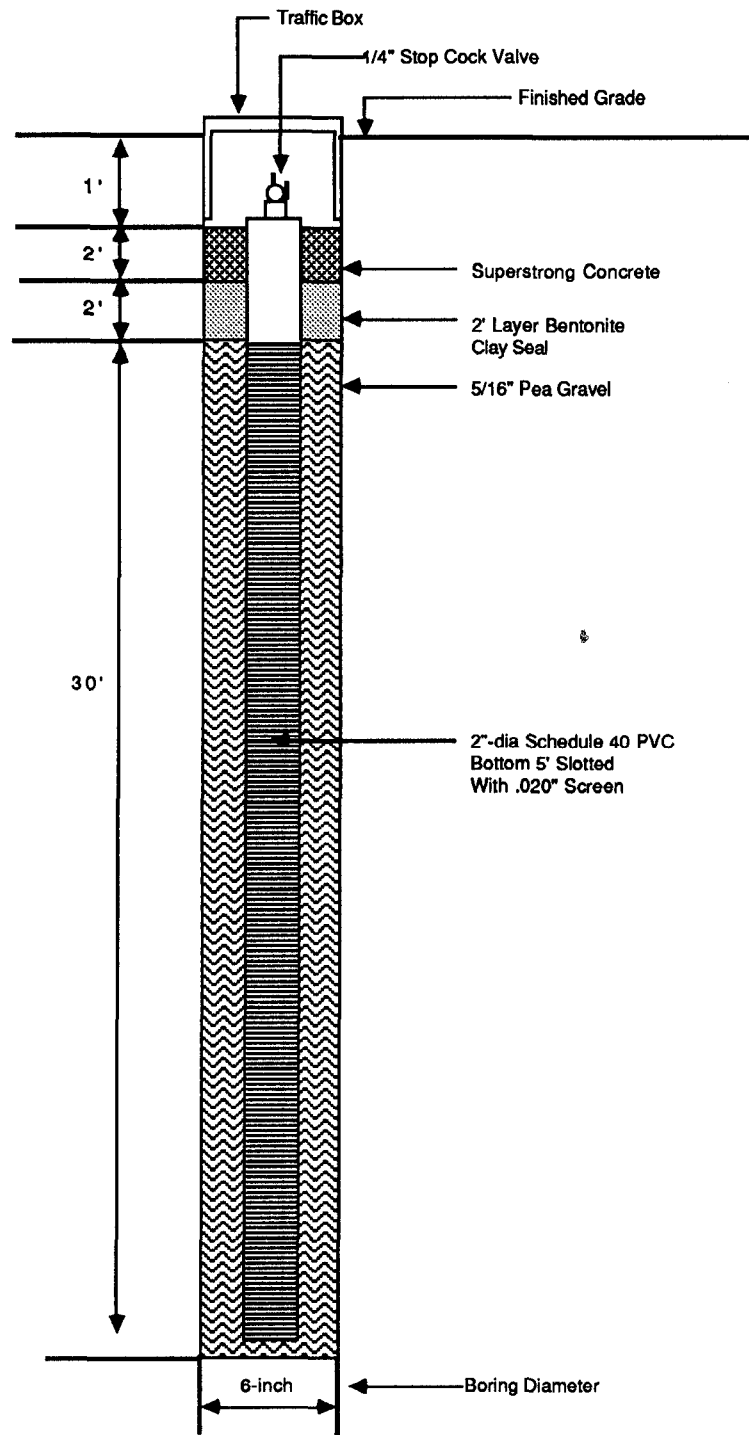
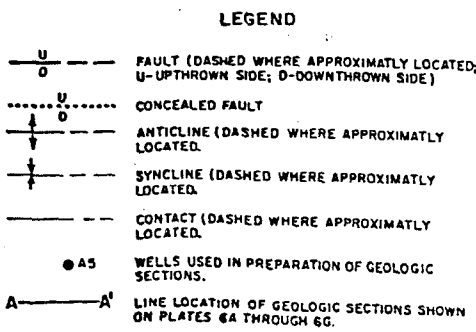
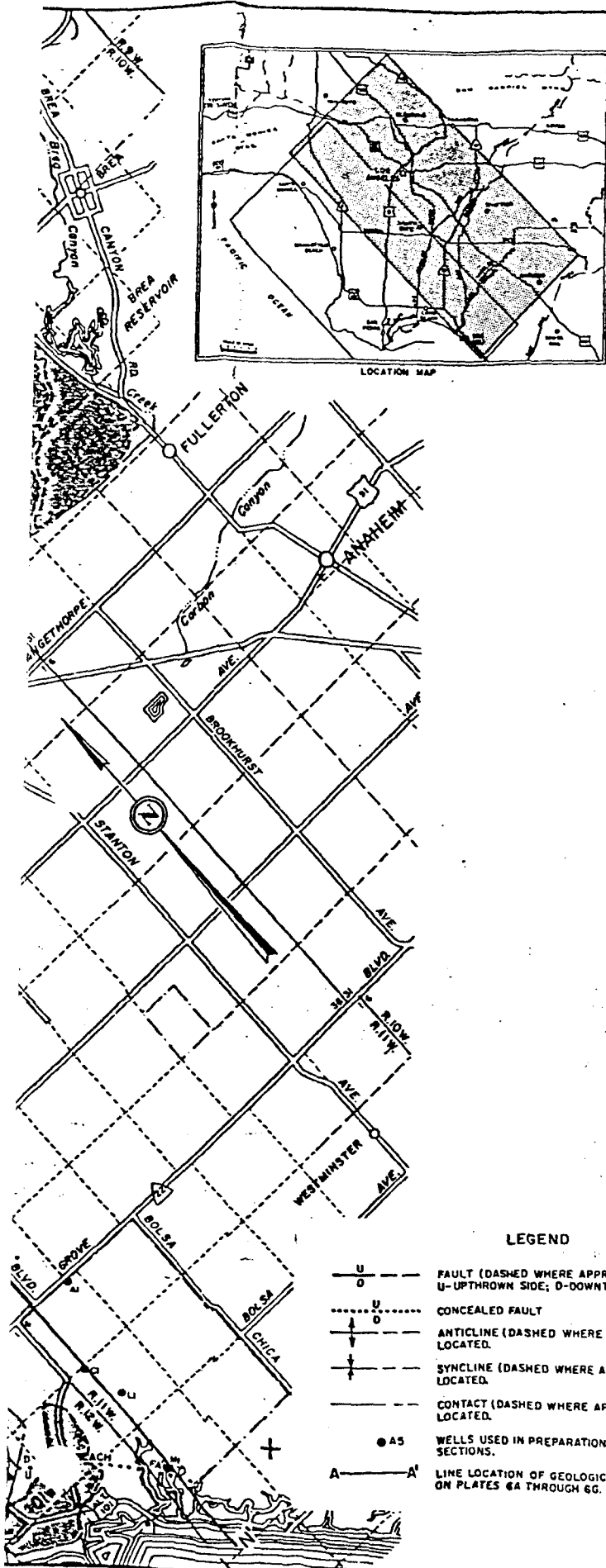


Figure  
Design of Typical Ebasco  
Vadose Zone Monitoring Well  
WDI





**LEGEND**

**SEDIMENTARY ROCKS**

QUATERNARY	RECENT	Q <sub>el</sub>	ALLUVIUM GRAVEL, SAND, SILT, AND CLAY
		Q <sub>af</sub>	ACTIVE DUNE SAND WHITE OR GREYISH, WELL SORTED SAND
PLEISTOCENE	UPPER	Q <sub>ol</sub>	OLDER DUNE SAND FINE TO MEDIUM SAND WITH SILT, AND GRAVEL LENSES
		Q <sub>lw</sub>	LAKEWOOD FORMATION (INCLUDES "TERRACE DEPOSITS," "PALOS VERDES SAND," AND "UNNAMED UPPER PLEISTOCENE DEPOSITS") MARINE AND CONTINENTAL GRAVEL, SAND, SANDY SILT, SILT, AND CLAY WITH SHALE PEBBLES
	LOWER	Q <sub>sp</sub>	SAN PEDRO FORMATION (INCLUDES "LA HABRA CONGLOMERATE" AND PART OF "SAUGUS FORMATION") MARINE AND CONTINENTAL GRAVEL, SAND, SANDY SILT, SILT, AND CLAY
		Q <sub>un</sub>	UNDIFFERENTIATED SAN PEDRO FORMATION AND/OR PICO FORMATION MARINE, PARTIALLY CONSOLIDATED GRAVEL, SAND, SILT, AND CLAY
PLIOCENE		P <sub>1</sub>	PICO FORMATION MARINE SAND, SILT, AND CLAY INTERBEDDED WITH GRAVEL
		P <sub>2</sub>	REPETTO FORMATION MARINE SILTSTONE WITH LAYERS OF SANDSTONE AND CONGLOMERATE
		P <sub>3</sub>	(SANTA MONICA MOUNTAINS) MODELO FORMATION MARINE CONGLOMERATIC SANDSTONE, SANDSTONE, AND SHALE TOPANGA FORMATION MARINE CONGLOMERATE, SANDSTONE, AND SHALE
TERTIARY	MIocene	M <sub>1</sub>	(PALOS VERDES HILLS) MONTEREY FORMATION MUDSTONE, DIATOMITE, AND SHALE (ELYSIAN HILLS, REPETTO HILLS, AND PUENTE HILLS) PUENTE FORMATION MARINE SILTSTONE, SANDSTONE, SHALE, CONGLOMERATE, LIMESTONE, AND TUFF
	OLIGOCENE(?)	O <sub>1</sub>	VAQUEROS AND SESPE FORMATIONS CONTINENTAL RED CONGLOMERATE AND SANDSTONE
	Eocene	E <sub>1</sub>	MARTINEZ FORMATION MARINE CONGLOMERATE, SANDSTONE, SANDY SHALE, AND SHALE
	PALEOCENE(?)	E <sub>2</sub>	UNDIVIDED MARTINEZ AND CHICO FORMATIONS
CRETACEOUS	UPPER	C <sub>1</sub>	CHICO FORMATION UPPER MARINE MEMBER—HARD CONGLOMERATE, SANDSTONE, AND SHALE LOWER CONTINENTAL MEMBER—RED CONGLOMERATE AND SANDSTONE

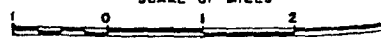
**IGNEOUS AND METAMORPHIC ROCKS**

TERTIARY	MIocene	M <sub>1</sub>	MIDDLE MIOCENE VOLCANIC ROCKS VOLCANIC FLOWS, BRECCIAS, TUFFS, AND INTRUSIVES, CHIEFLY BASALTIC AND ANDESITIC WITH OCCASIONAL ACID ROCKS, GENERALLY ASSOCIATED WITH TOPANGA, MODELO, OR PUENTE FORMATIONS
	UPPER	C <sub>1</sub>	(SANTA MONICA MOUNTAINS) INTRUSIVES OF GRANITE AND GRANODIORITE
TERTIARY	UPPER	C <sub>1</sub>	(PALOS VERDES HILLS) CATALINA SCHIST, COMPARED WITH FRANCISCAN FORMATION OF THE COAST RANGES, VARIED TYPES OF SCHISTOSE ROCKS
		C <sub>1</sub>	SANTA MONICA SLATE GREY TO BLACK SLATE, SPOTTED SLATE, MICA SCHIST WITH QUARTZ VEINS

STATE OF CALIFORNIA  
DEPARTMENT OF WATER RESOURCES  
SOUTHERN CALIFORNIA DISTRICT  
**GROUND WATER GEOLOGY OF THE  
COASTAL PLAIN OF  
LOS ANGELES COUNTY**

**AREAL GEOLOGY**

SCALE OF MILES



1961





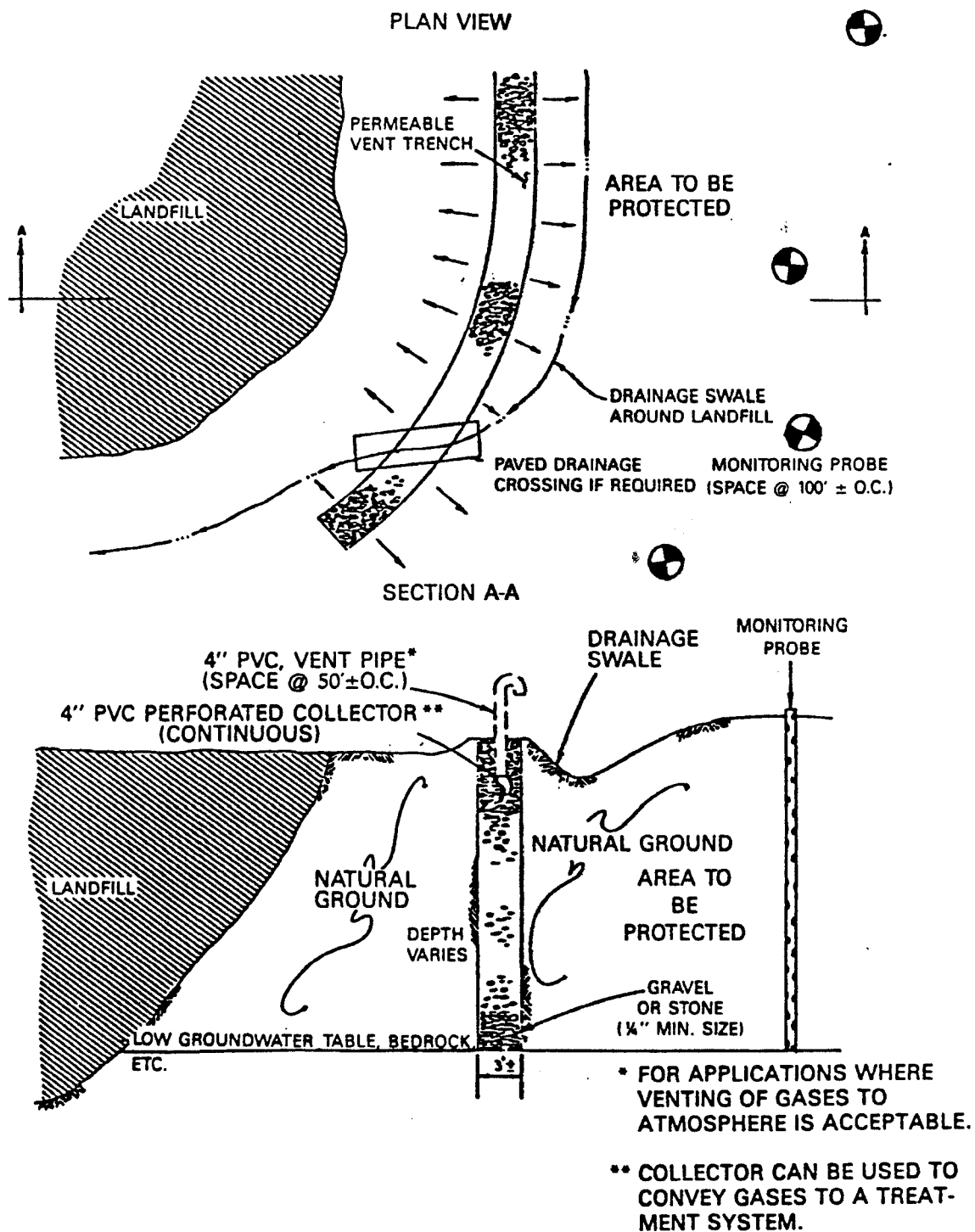


Figure 2-26

### Passive Gas Control Using a Permeable Trench

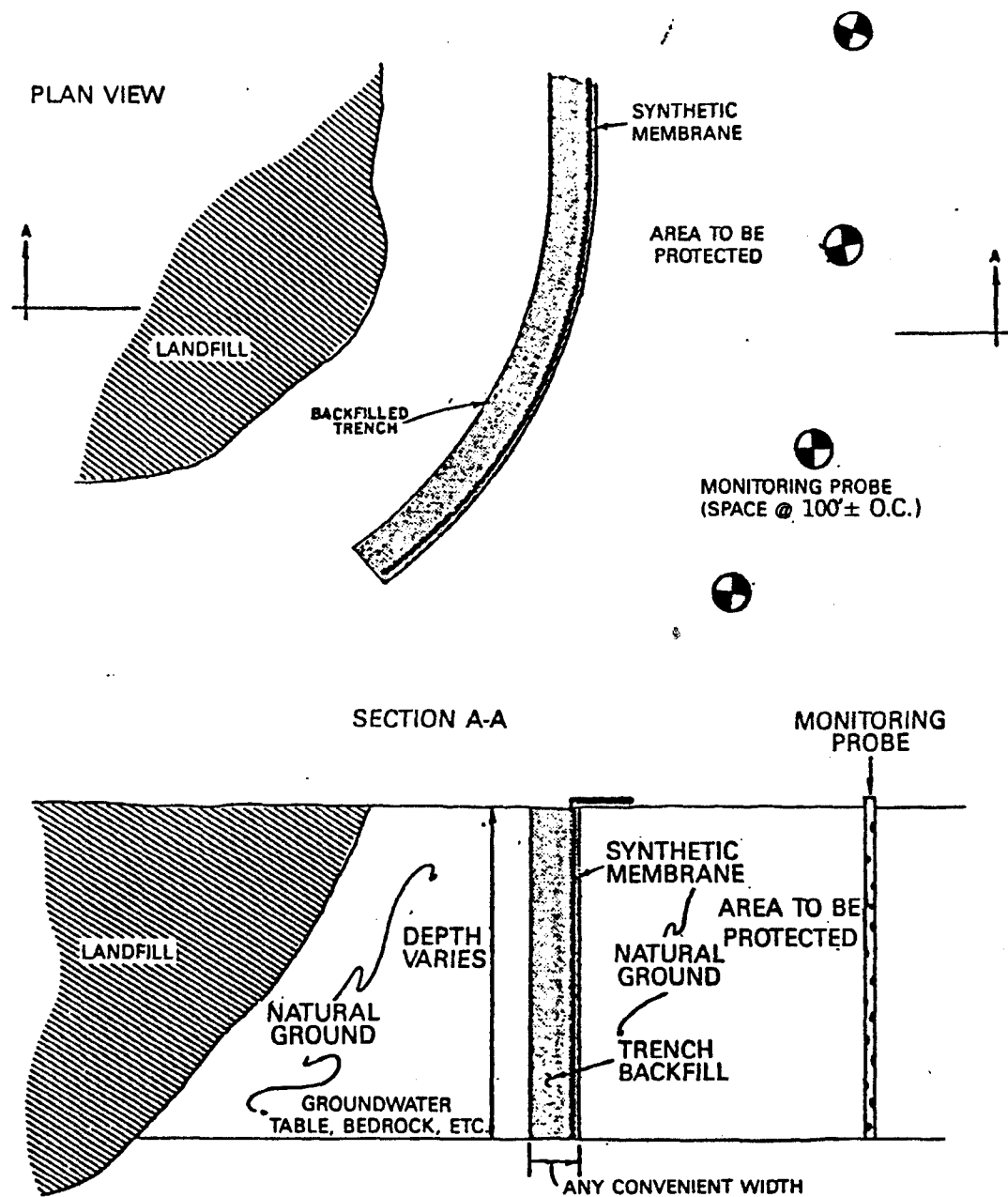


Figure 2-27

### Passive Gas Control Synthetic Membrane

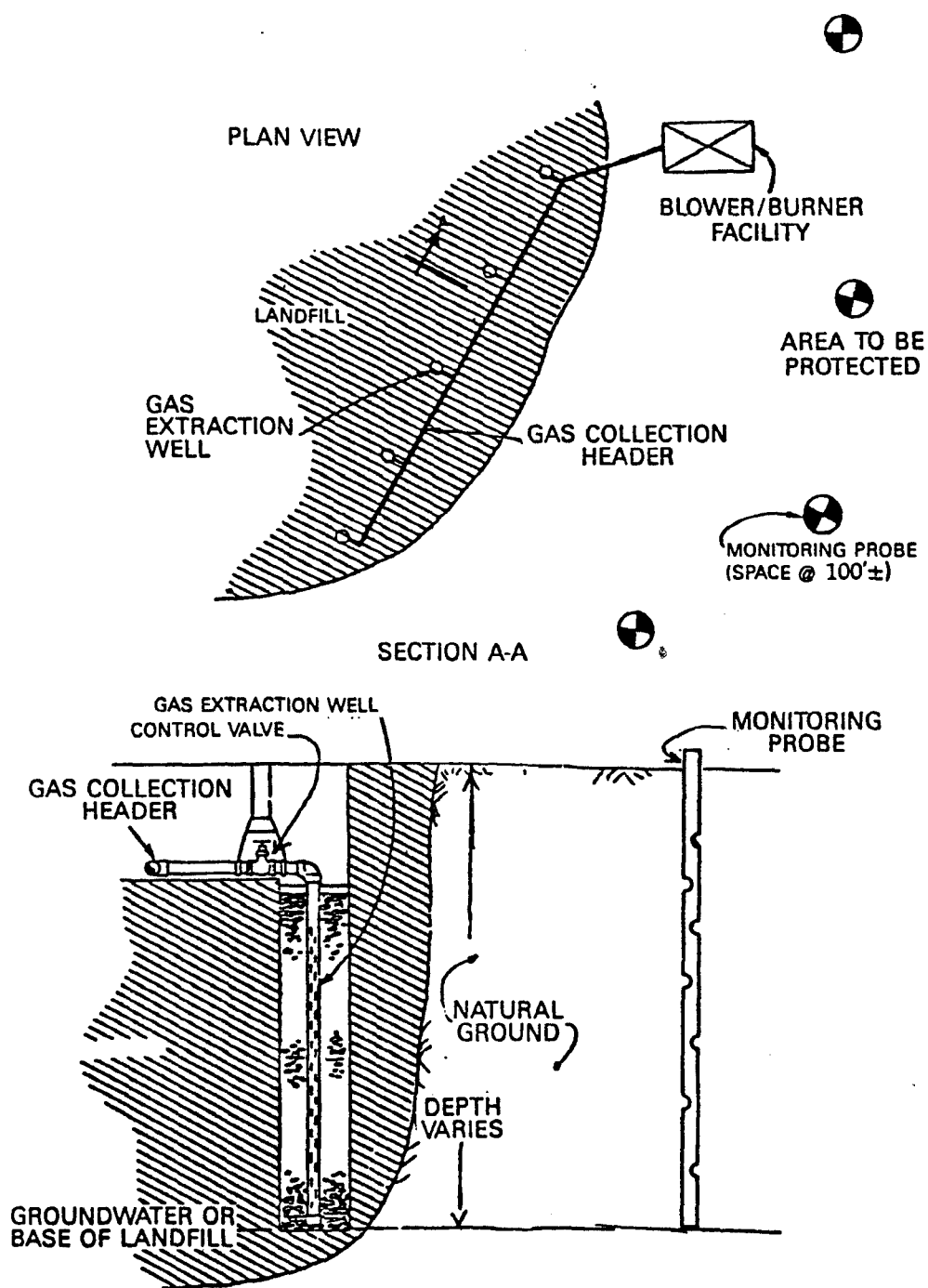


Figure 2-28

### Active Gas Extraction

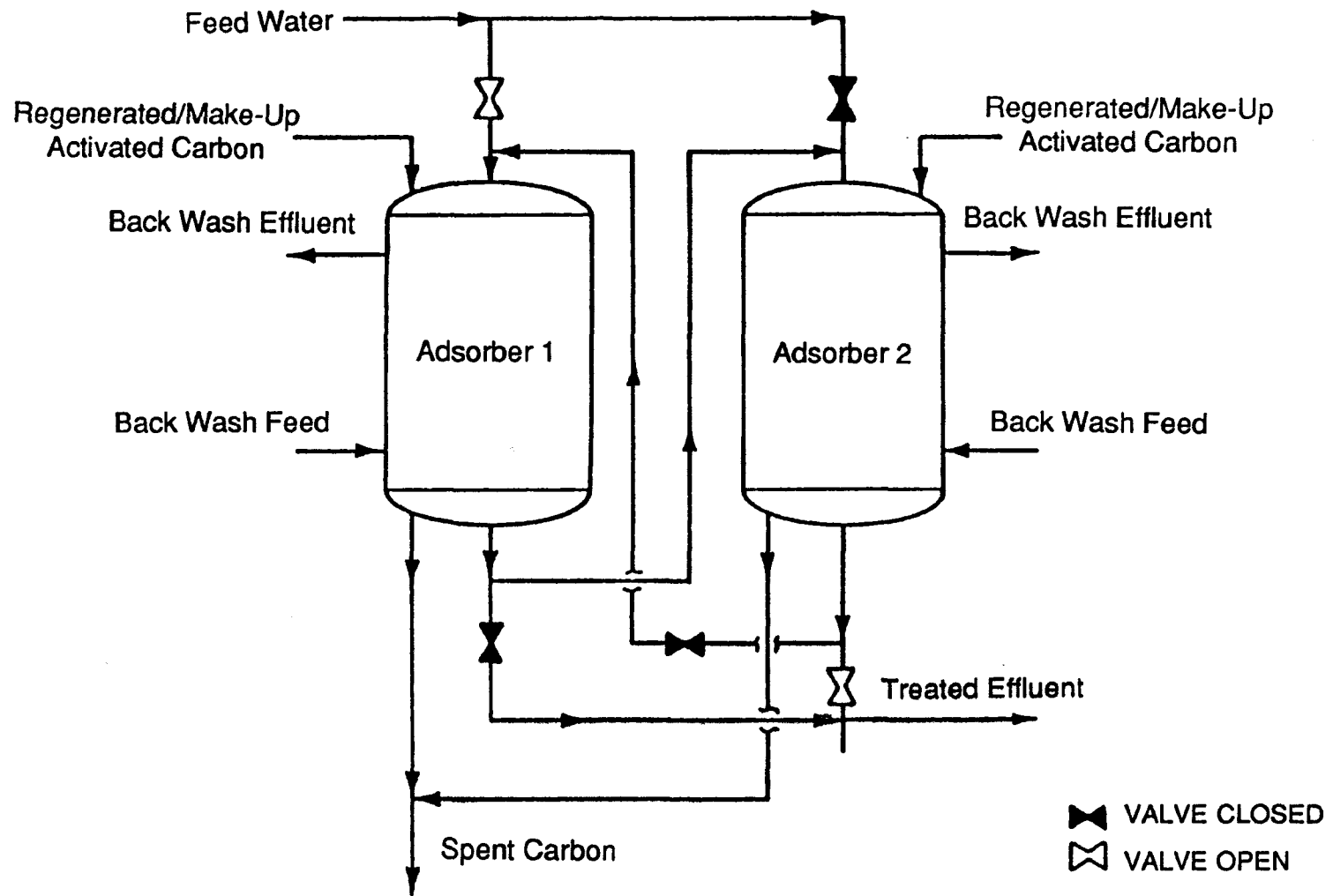
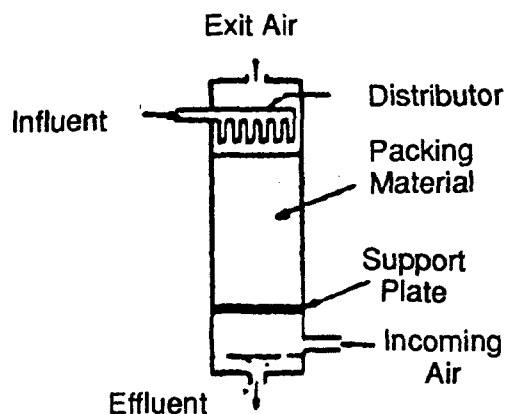


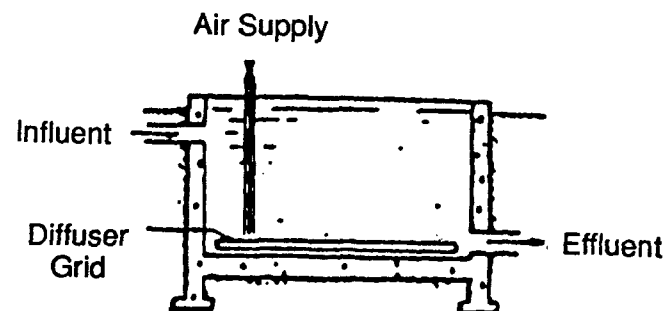
Figure 2-29

### Two-Vessel Granular Carbon Adsorption System

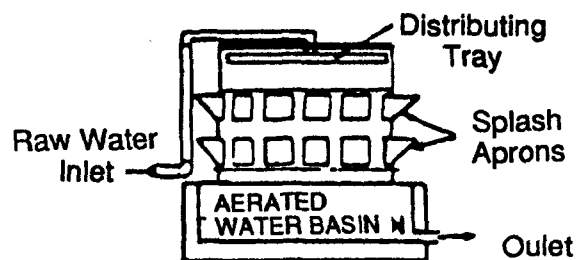
### PACKED COLUMN



### DIFFUSED AIR BASIN



### COKE TRAY AERATOR



### CROSS-FLOW TOWER

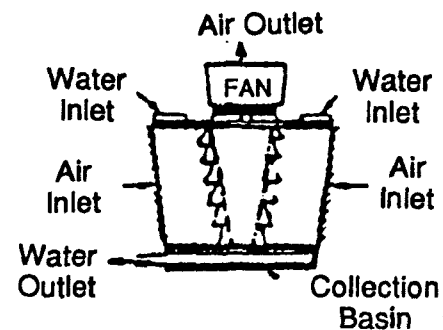


Figure 2-30

## Air Stripping Equipment Configurations

SOURCE: Canter and Knox (1985)

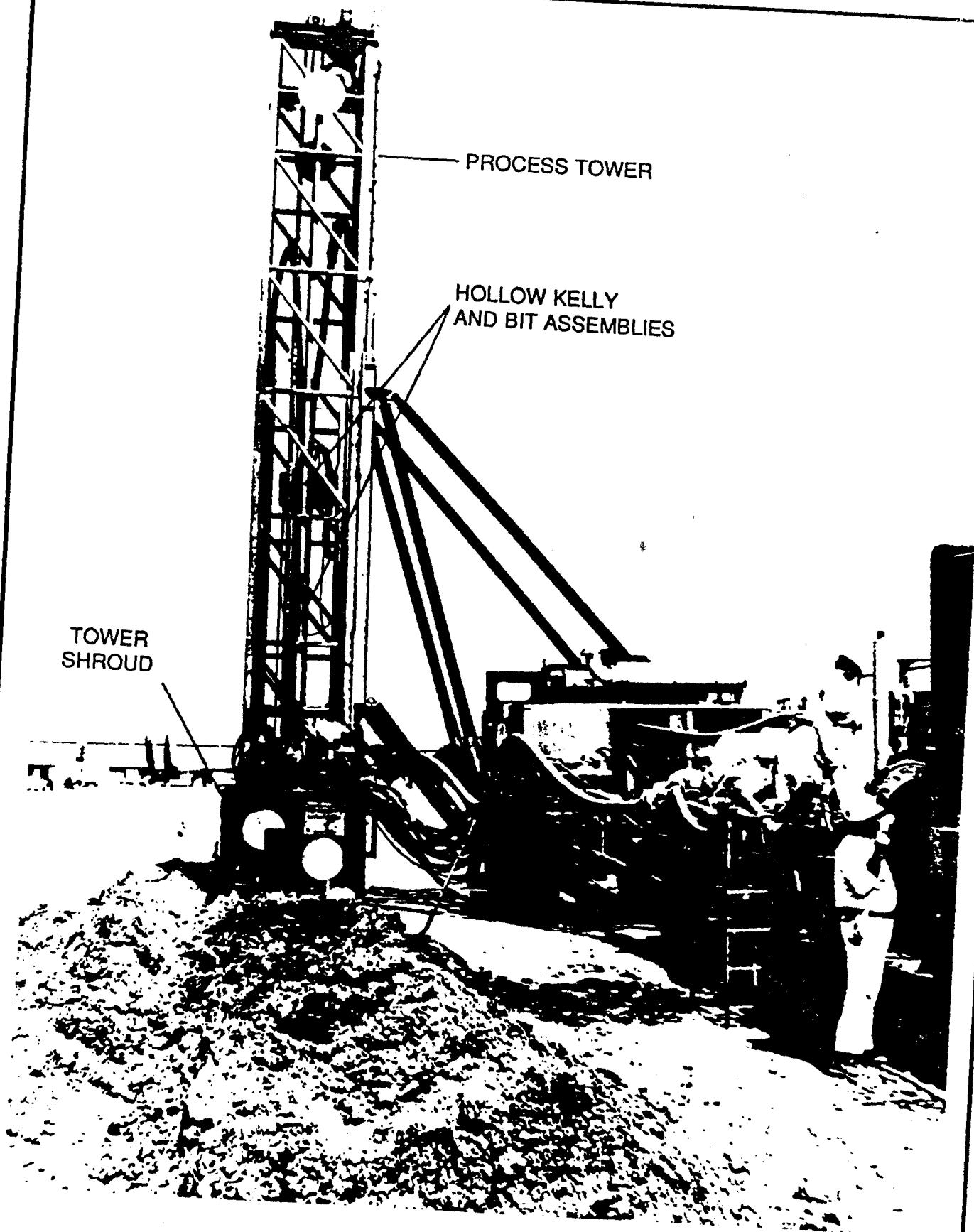
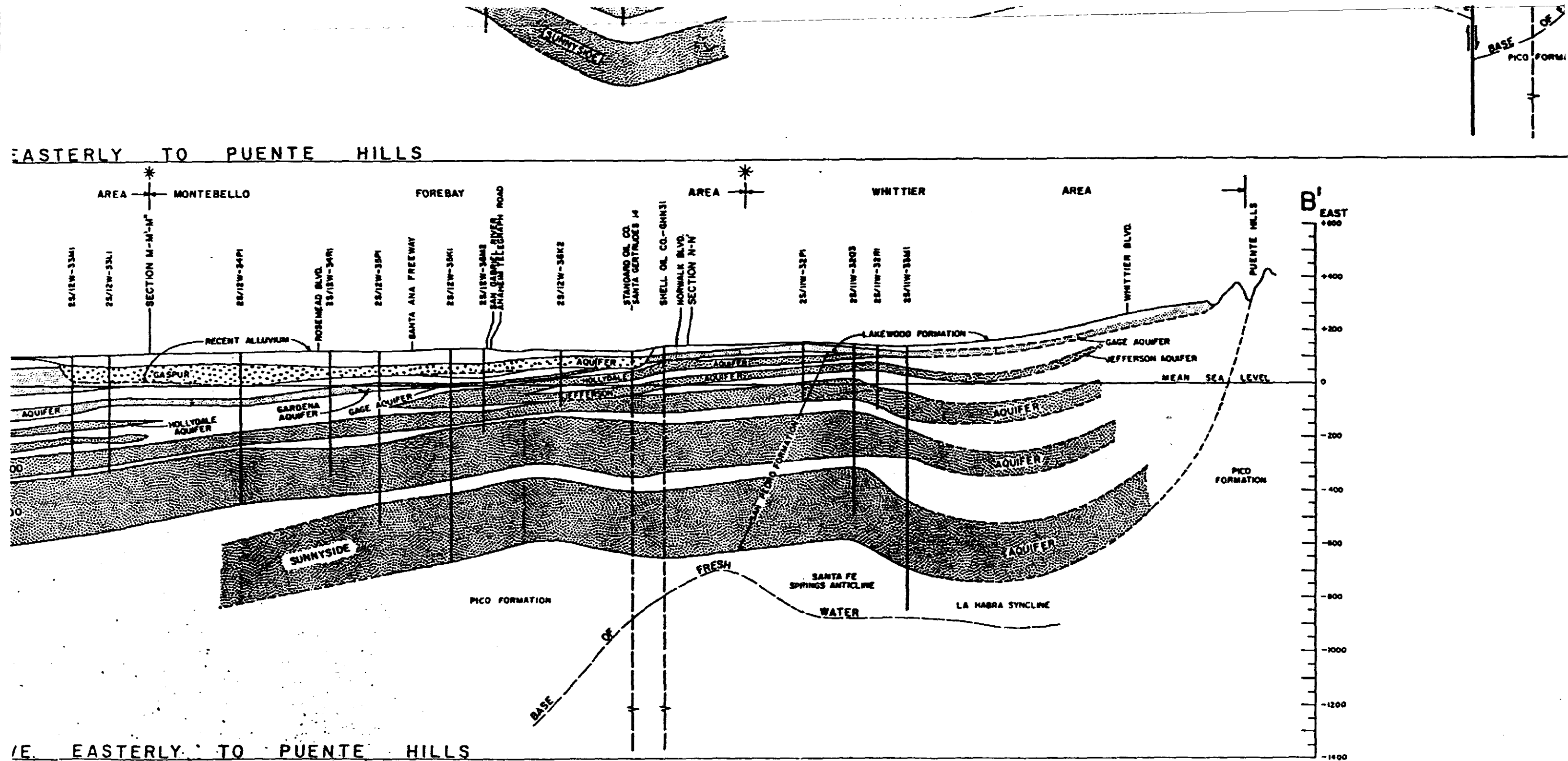
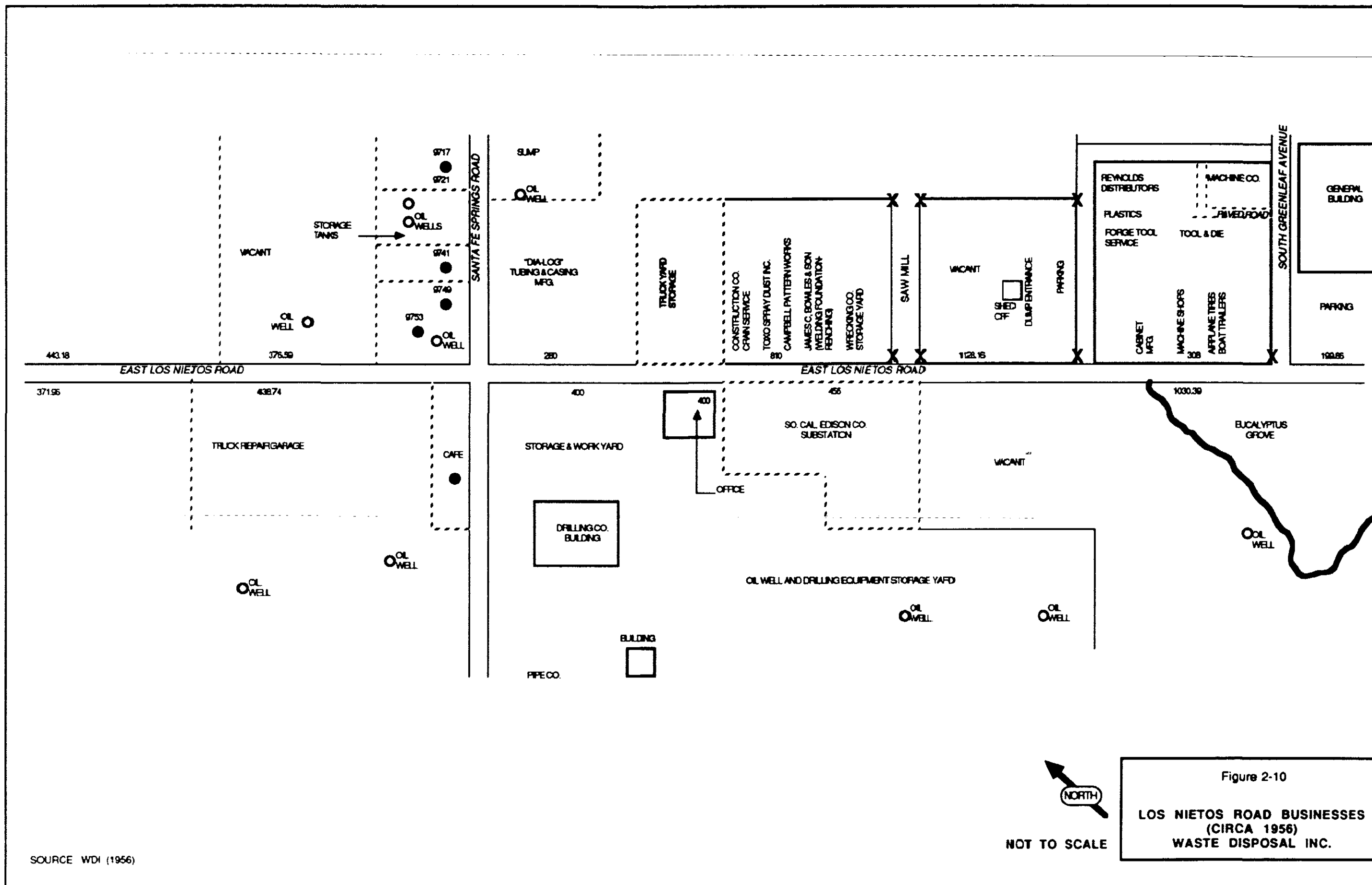


Figure 2-32

The In Situ Detoxifier



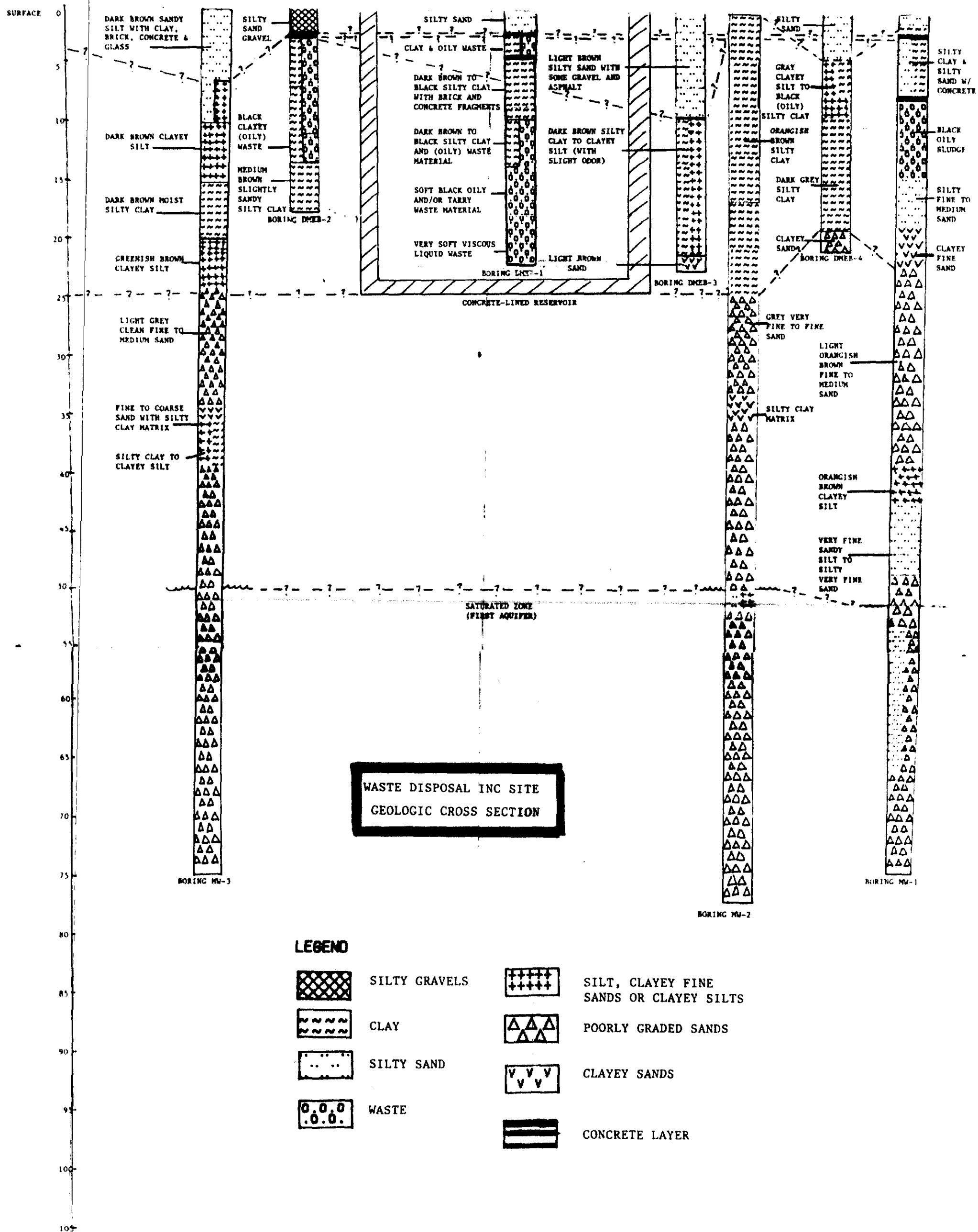


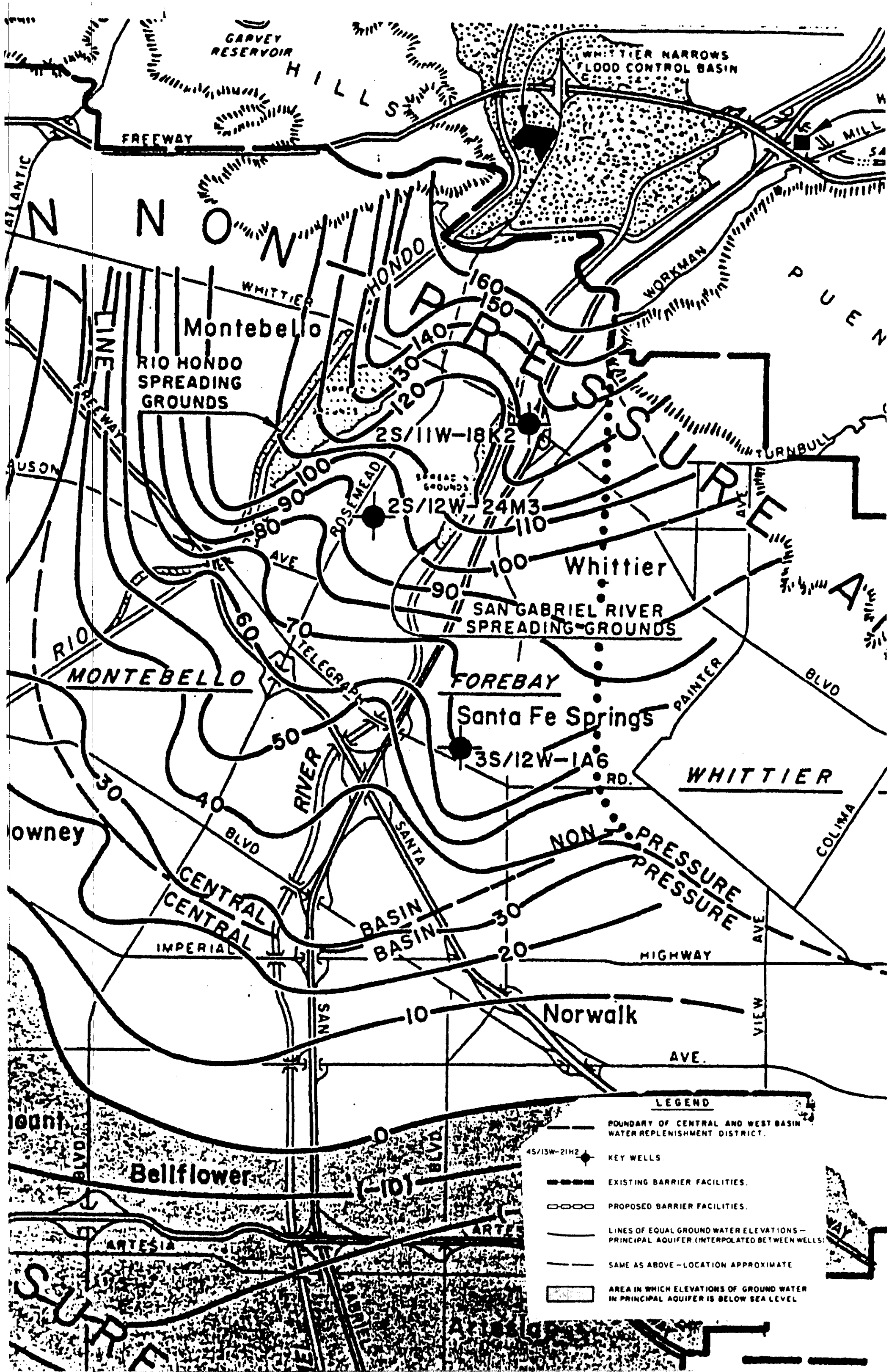
SOURCE WDI (1956)

Figure 2-10  
 LOS NIETOS ROAD BUSINESSES  
 (CIRCA 1956)  
 WASTE DISPOSAL INC.



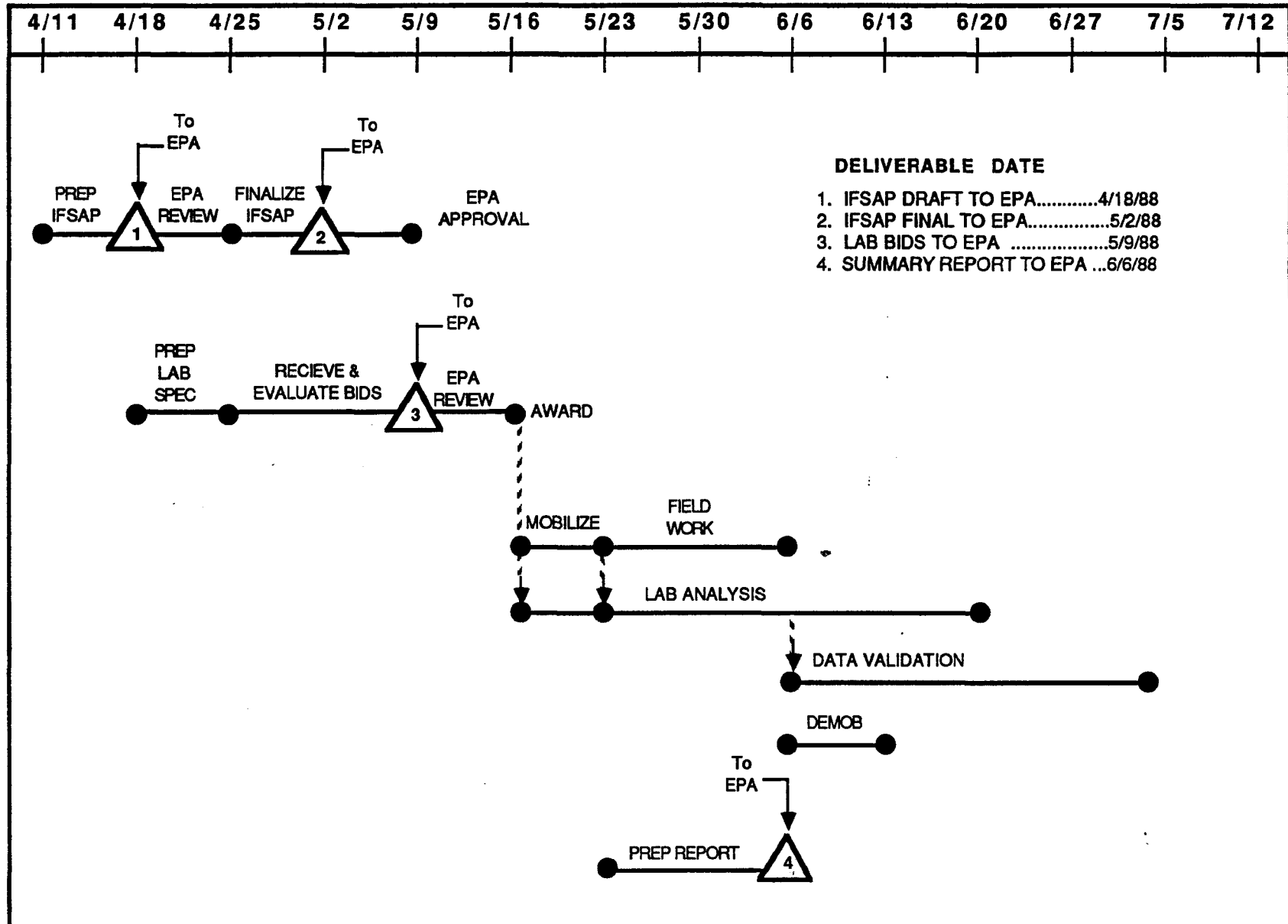


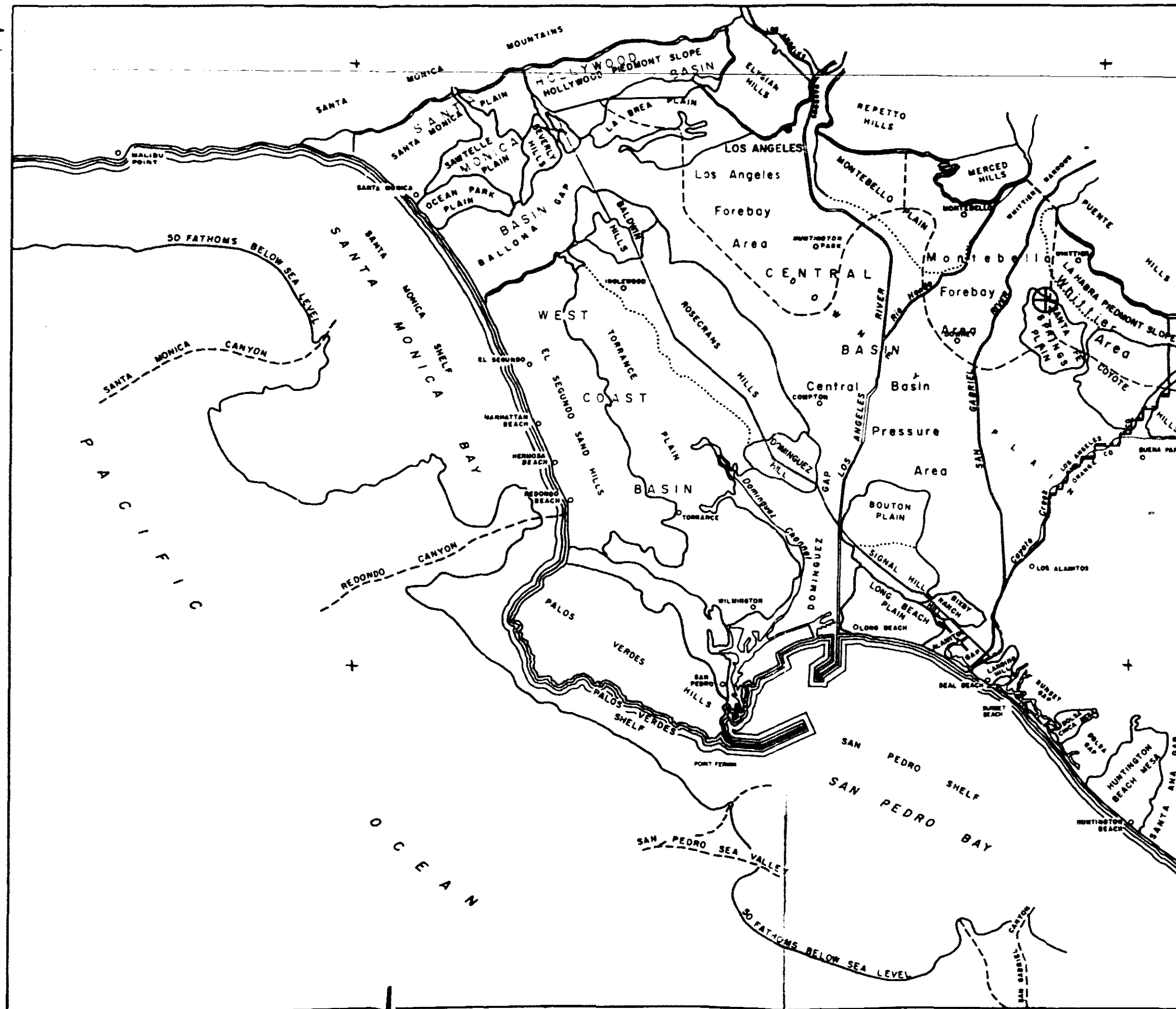




# WASTE DISPOSAL INC. PROJECT SCHEDULE

## Interim Field Sampling and Analysis





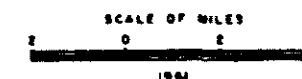
LEGEND

- BOUNDARY BETWEEN PHYSIOGRAPHIC FEATURES (DOTTED WHERE APPROXIMATE OR POORLY DEFINED)
- BOUNDARY OF GROUND WATER BASIN
- BOUNDARY OF FOREBAY AND WHITTIER AREA
- AXIS OF SUBMARINE CANYON

BOUNDARY BETWEEN FOREBAY AND PRESSURE AREA FROM BULLETIN 48 (CALIF. D.W.R. 1934)

STATE OF CALIFORNIA  
DEPARTMENT OF WATER RESOURCES  
SOUTHERN CALIFORNIA DISTRICT  
GROUND WATER GEOLOGY OF THE  
COASTAL PLAIN OF  
LOS ANGELES COUNTY

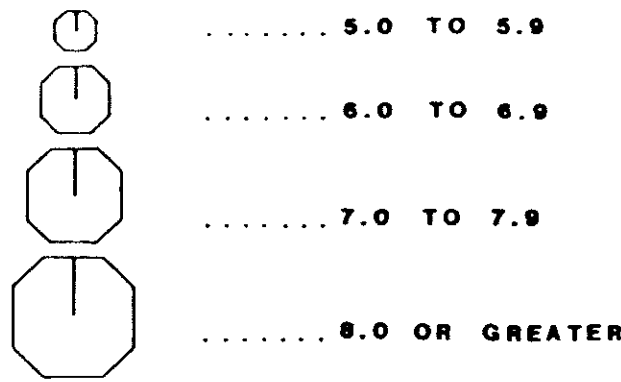
PHYSIOGRAPHIC FEATURES AND  
GROUND WATER BASINS





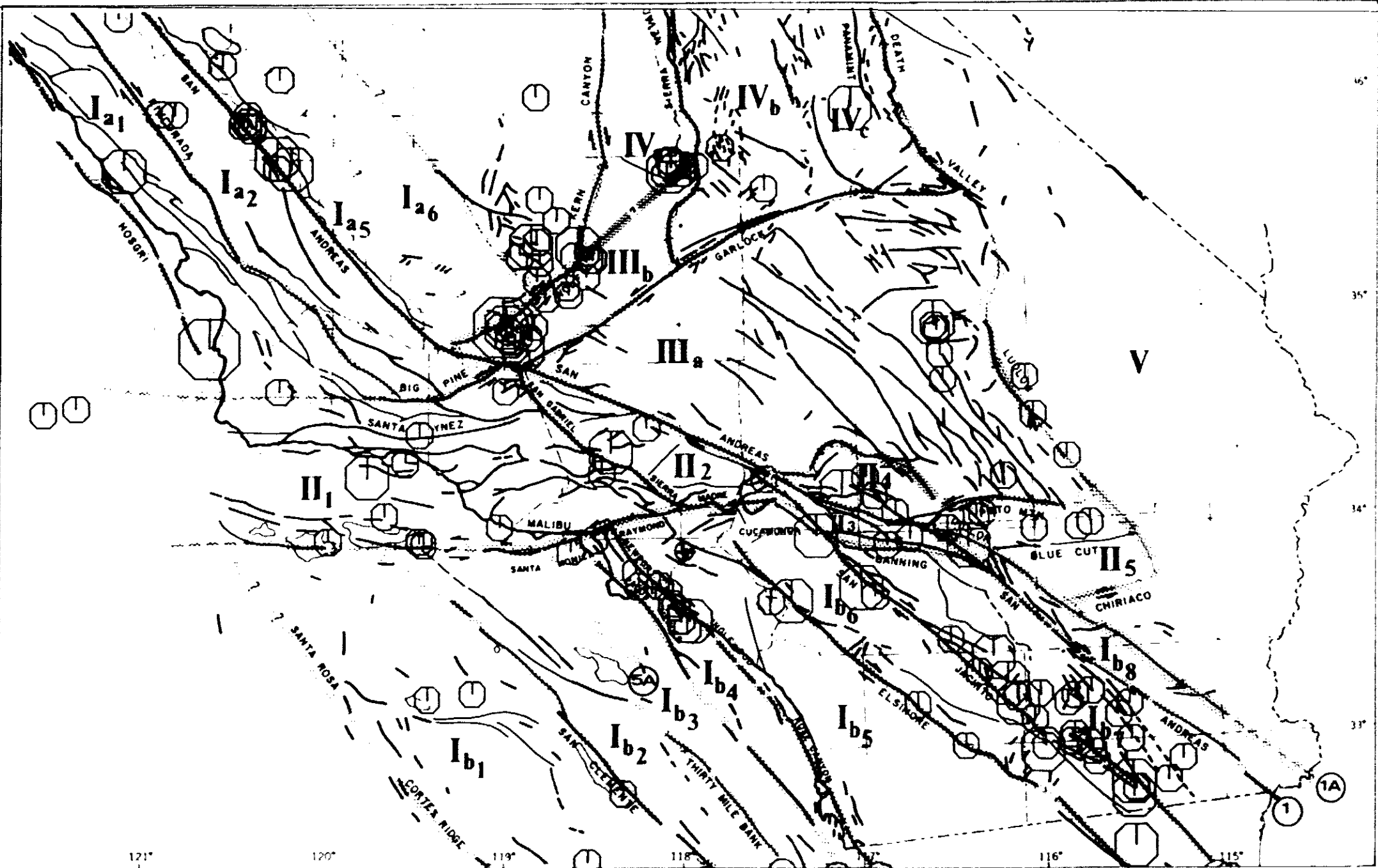
RELATIONSHIPS OF EARTHQUAKE EPICENTERS TO FAULTS IN SOUTHERN CALIFORNIA

MAGNITUDE



FAULT PATTERNS  
(Defining Blocks and Subblocks)

Structural Province	Predominant Fault Trend	Blocks	Sub-block
I	NW (San Andreas trend)	a Coast Ranges	1 Santa Lucia 2 Gabilan 3 San Francisco 4 Berkeley 5 Diablo 6 Great Valley 7 Stonyford
		b Peninsular Ranges	1 San Clemente 2 Catalina 3 Palos Verdes 4 Inglewood-San Diego 5 Santa Ana 6 Riverside 7 San Jacinto 8 Indio Hills-Mecca Hills
II	E-W (transverse trend)	Transverse Ranges	1 Santa Ynez 2 San Gabriel 3 Banning 4 San Bernardino 5 Pinto Mtns
III	NE (Garlock trend)	a Mojave b Tehachapi	
IV	N-S (Quena Valley trend)	a Kern Canyon b Pamamint c Death Valley d Warner e East Sierra f Cascade g Gorda	
V	Multiple	Sanoran Desert	
VI	Complex	Sierra Nevada	
VII	Thrusts	Klamath	
VIII	Complex	Modoc	1 Alturas 2 Eagle Lake 3 Diamond Mtns 4 Medicine Lake



BOUNDARIES (Segmented where projected, queried where very speculative)		
Boundary defined by	Major Structural Block	Structural Sub-block
	Quaternary fault	Quaternary fault
	Pre-Quaternary fault	Pre-Quaternary fault
	Minor Pre-Quaternary fault or (fault not shown)	Minor Pre-Quaternary fault or (fault not shown)

• Pre-Quaternary faults may include a fault whose age is unknown or has not been evaluated; it may in fact, be Quaternary



AFTER JENNINGS (1985)

FIGURE

PACIFIC SOILS ENGINEERING, INC.  
17808 FITCH IRVINE, CA (714) 963-8718  
W.O. DATE